THE COMPLEAT Ship-Wright.

Plainly and Demonſtratively Teaching the Proportions uſed by Experienced *Ship-Wrights*, according to their Cuſtome of Building; both *Geometrically* and *Arithmetically* performed.

To which is added,

Certain Propoſitions in *Geometry*, the uſe of a *Diagonall SCALE*, to draw a *Draught*, with the Making, Graduating, or Marking of a Bend of *Moulds*, and ordering of the ſame. The Extraction of the *Square Root*, with a *Table* of *Squares*.

Alſo, a way of Rowing of *Ships*, by heaving at the *Capſtant*, uſefull in any *Ship* becalm'd; with other things uſefull in that *ART*.

By EDMUND BUSHNELL *Ship-Wright*.

LONDON,
Printed by *W. Leybourn* for *George Hurlock*, and are to be ſold at his Shop at *Magnus* Church corner in *Thames*-Street, neer *London*-Bridge, 1664.


BIBLIOTHECA BODLEIANA

Sr. John Aubrey R.S.S. 1664

TO THE READER.

Friendly Reader,



THe *Matter contained in this* Treatiſe, *is written onely for the good and profit of my Countrymen, who are ſtill in that capacity that once I my ſelf was*; *that is, ignorant of what they ſhould know in their* Trades, *and deſire Inſtruction*; *not that I preſume to teach thoſe long experienced* Ship-Wrights, *whoſe actions hath declared their Abilities to the whole World, in their Building of ſo Gallant, and Serviceable a Fleet of Ships, as at preſent his* Majeſty, *the King of* England, *is furniſhed withall, no King having the like, either for Offence, or Defence: yet their knowledge they deſire to keep to themſelves, or at leaſt among ſo ſmall a number as they can*; *for although ſome of them have many Servants, and by Indenture*

(I ſuppoſe) bound to Teach them all alike the ſame Art and Myſtery that he himſelf uſeth; Yet it may be he may Teach ſome one, and the reſt muſt be kept ignorant, ſo that thoſe Ship-Wrights, although bred by ſuch knowing Men, yet they are able to teach their Servants nothing, more then to Hew, or Dub, to Fay a Piece when it is Moulded to his place aſsigned, or the like: but if occaſion require, that the greateſt part of theſe Men, by being Carpenters of Ships, or the like, may be removed from England to Virginia, or New-England, or the like Countryes, where Timber is pleuty for their uſe, yet through their ignorance, they durſt not undertake ſuch a Work: For their ſakes I have written this Book, wherein the Reader ſhall finde inſtructions ſufficient for Moulding of any Ship, or Veſſell whatever, with the Maſting of them, drawing of Draughts, and all in a very plain and exact Method, which I am confident will be underſtood by the meaneſt capacities, if they can but read Engliſh, and have the benefit of a little Arithmetick, as Adition, Subſtraction, Multiplication, Diviſion: be diligent, and I ſhall be thereby incouraged, if need be, to help thee farther in the Art.

Farewell,

Thy Friend,

Edmund Buſhnell.

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Advertiſement.

IF any Gentleman, ſtudious in the *Mathematicks*, have, or ſhall have occaſion for Inſtruments thereunto belonging, they may be furniſhed with all ſorts, uſefull both for Sea or Land, either in Braſs, or Wood, by *Walter Hayes*, at the *Croſs-Daggers* in *Moore-Fields*, next door to the *Popes-Head* Tavern; where they may have all ſorts of Maps, Globes, and Mathematicall Paper, Carpenters Rules, Poſt and Pocket-Dyalls for any Latitude, Steel Letters, Figures, Signes, Planets, or Aſpects, at reaſonable Rates.

ERRATA.

Page	Line	Read
7,	9,	Halſes
8	16	come not fowl
8	21	faied
11	2	at *f* or G
12	23	afore
13	2	afore
23	19	aftward
24	15	L 2
24	28	$\frac{2}{3}$
25	25	dele off
26	7	Sirmarks
28	0	none, that
28	11	at the top
19	2	ſtick
20	29	you hew to
22	5	make a
23	3&5	$\frac{1}{7}$
54	16	12 foot
57	1	two laſt numbers.

Books *Printed and Sold by* George Hurlock, *at* Magnus Church-Corner *in* Thames-Street, *neer* London Bridge.

Seamans Kalender, or *Ephemerides* of the Sun, Moon, and certain of the most notable fixed Stars, *&c.*

Norwoods Doctrine of Triangles, with Logarithmes, lately printed, exactly corrected, and much inlarged by the Author himself. *Norwoods* Epitomy, applyed to plain and Mercators sailing. *Norwoods* Sea mans Practice, containing a Fundamentall Probleme in *Navigation*, experimentally verified. Safeguard of Saylors, or Great Rutter, by *Io. Norman*. Sea mans secrets. A Table of Gauging all manner of Vessels, by *Jo. Goodwin*. Path-way to perfect sailing, by *Richard Potter*. *Pitiscus* his Doctrine of Triangles, with Canons. *Navigator* by *Cap. Charles Saltonstal*, newly printed, with additions, shewing the Deceipts of the plain Charts used in our time, and a way to prove the projection of any Plain Chart. *Dary's* description and use of a Universall Quadrant. Seamans Dictionary, or the Exposition and Demonstration of all the parts and things belonging to a ship: together with an Explanation of all the Termes and Phrases used in the practique part of *Navigation*, by Sir *Henry Manwaring*.

Exact Tables of Naturall and Artificial Sines, Tangents, Secants and Logarithms, and an *Institution Mathematicall*, containing their constructions and use in the solution of all Triangles Plain and Spherical, and the application thereof in *Astronomy*, *Dialling*, and *Navigation*.

Seamans Glass, now newly published, with the addition of many propositions in *Navigation*, *Astronomy*, and *Dialling*, not before printed.

The Compleat Canoneer, shewing the principles and grounds of the Art of Gunnery, as also several Fire-Works for Sea and Land.

The Advancement of the Art of *Navigation*, or Sea-mans Canon of Triangles, shewing by a new Canon of Sines, Tangents, and Secants, how to resolve all Cases of right lined Triangles, onely by looking into the Tables, without any Calculation. Particularly applyed to all the three kindes of Sayling, *viz.* by the Plain Chart, Mercators Chart, by a Great Circle; and to the Art of *Surveying*.

Trigonometria Brittannica, or the Doctrine of Triangles, in *folio*, exhibiting the Logarithms of all numbers, from one to a hundred thousand, and the Sines and Tangents to the hundred part of a Degree, with Mr. *Gellibrands* Doctrine of Triangles, faithfully translated from the Latin Copy.

The Sector on a Quadrant, containing the Description and use of three generall

general Quadrants, accommodated for the ready finding the Hour and Azimuth universally in the equal Limbe.

The Compleat Modelist, shewing how to raise the Model of any Ship or Vessel, either in proportion, or out of proportion, and to find the length and bigness of every Rope, in all Vessels exactly; with the weight of their Anchors and Cables.

There is a new Book called the *Pilots Sea-Mirror*, which is a *Compendium* of the largest *magnitude*, or the lightning *Sea-Coelumbe*; Containing all Distances or thwart Courses of the *Eastern*, *Northern*, and *Western* Navigations, with a general Tide Table, for every day, and the Change and Full of the Moon exactly for eight years, also Courses and Distances throughout the Straights. Printed for *George Havlock*, at *Magnus Church Corner*, by *London* Bridge.

The Saints Anchor-hold in all stormes and Tempests, Published for the support and comfort of Gods people in all times of Trial, by *John Davenport* Pastor of the Church in *New-Haven* in *New-England*.

There will shortly be made publick a Book, Intituled, The *Mariners Compass Rectified*, containing, First, a Table shewing the hour of the day, the Sun being upon any point of the Compass. Secondly, Tables of the Suns rising and setting. Thirdly, Tables shewing the points of the Compass, that the Sun and Stars rise and set with. Fourthly, Tables of Amplitudes; all which Tables are Calculated from the Equinoctial, to 60 degrees of Latitude, with Tables of Latitudes and Longitudes, after a new order, with the description and use of all those Instruments that are in use in the *Art* of Navigation, either for *Operation* or *Observation*.

THE COMPLEAT Ship-wright.

CHAP. I.

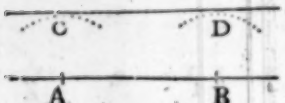
Of Geometricall Problemes.

BEfore we proceed to draw the Draught of any Ship or Veſſel, it will be neceſſary to be acquainted with ſome terms in *Geometry*: as to know what a Point and a Line meaneth, which every Book treating of Geometry plainly teacheth, and therefore we ſhall paſſe that by, ſuppoſing that none will endeavour to ſtudy the Art of a Ship-wright, that is ignorant of theſe things: and therefore leaving theſe *Definitions*, I will proceed to ſome *Geometrical Problemes* neceſſary to this Art.

PROB. 1.

How to draw a Parallel Line.

PArallel lines are such lines as are equidistant one from another in all parts, and are thus drawn. Draw a line of what length you please, (according to your occasion) as the line A B, then open the compasses to what distance you pleas, or as your occasions require, and set one foot of the compasses towards one end of the given line, as at A, with the other foot make a piece of an arch of a circle, over or under the given line, as the arch C, keeping the compasses then at the same distance, make such another arch towards the other end of the line, setting one foot in B, and with the other describe the arch D, then laying a Ruler to the outside of these two arches, so that it may exactly touch them, draw the line C D, which will be parallel to the given line A B, or equidistant, for so signifieth the word Parallel, to be of equal distance.



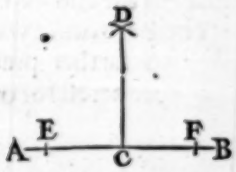
PROBL. 2.

How to erect a Perpendicular, from a point in a right line given.

LEt there be a point given in the line A B, as the point C, whereon to raise a perpendicular.

Set one foot of the compasses in the given point C, and open them to what distance you please, as to the point E, make a little mark at E, and keeping the compasses at the same

ſame diſtance, turn them about, and make a mark at the point F, in the line A B: Then remove the compaſſes to one of thoſe marks at E or F, and ſeting one foot faſt therein, as at the point F, open the other foot wider, and therewith draw a ſmall arch over the point C, as the arch D, then keeping the compaſſes at the ſame diſtance, remove them to E, and ſeting one foot in E, with the other foot draw another little arch, ſo as to croſſe the former arch in the point D, through the croſſing of theſe two arches A D, draw a line to the given point C, as the line D C, which ſhall be perpendicular to the line A B.

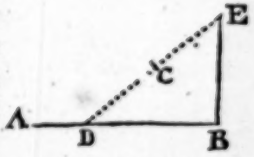


Diverſe other wayes there are to raiſe a perpendicular, which I ſhall leave to the farther practice of ſuch as deſire diverſity of wayes, and proceed to the raiſing of a Perpendicular on the end of a line.

PROBL. 3.

To raiſe a Perpendicular on the end of a line.

DRaw a line at pleaſure, or according to your worke, as the line A B: On the end thereof as at B, ſet one foot of the Compaſſes, and open them to what wideneſſe you pleaſe, as to C, and keeping faſt one foot at B, pitch one foot by adventure in C, then keeping one foot of the compaſſes in C, and at the ſame diſtance, remove the foot that was in B, to the point D in the line A B: then (keeping the compaſſes ſtil at the ſame diſtance) lay a ruler to the points D and



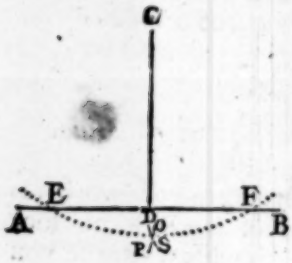
C, & with your compaſſes ſet off the diſtance from C to E: Laſtly, draw the line E B, which will be perpendicular or ſquare to the end of the given line A B.

There are other wayes to effect this, which I ſhall leave to farther practice of the learner, this being the propereſt for our purpoſe.

PROB. 4.

From a Point given, to let fall a Perpendicular upon a Line given.

FRom the point C, let it be required to let fall a perpendicular upon the line A B, proceed thus: Fix one foot of the compaſſes in the point C, and open them to a greater diſtance then juſt to the line A B, and make with the ſame extent the two marks E and F, in the given line A B, then divide the diſtance betweene the two points E and F into two equall parts in the point D, then lay a Ruler to the given point C, and to the point D, and draw the line C D, which will be perpendicular to the given line A B.

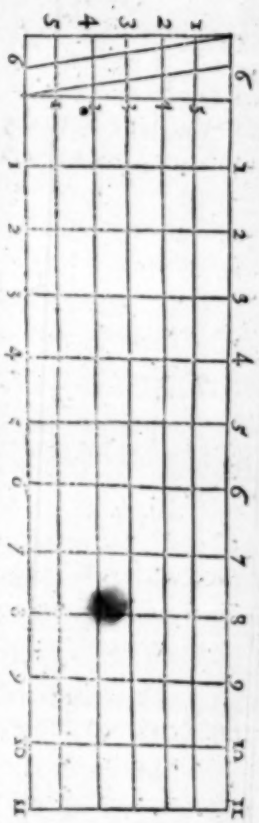


CHAP. II.

Of your SCALE.

BEing perfect in the raiſing and letting fall of perpendiculars, and in the drawing of Parallel lines, you may proceed to draught: But firſt I will unfold unto you

you the uſe of a Diagonall Scale of Inches and Feet, whoſe uſe is to repreſent a foot meaſure, or a Rule ſo ſmall, that a Ship of 100 foot by the Keel, may be demonſtrated on a common ſheet of paper, really and truly to be ſo many foot long, and ſo many foot broad, of ſuch a depth, and of ſuch a height between the Decks. And therein, the firſt thing to be conſidered is, the length of the platform, and of the Veſſel you intend to demonſtrate, to the end you may make your Scale as large as you can, becauſe the larger the Scale is, the larger will the draught be, and ſo the meaſure of the demonſtration will be the larger, and more eaſie to unfold. The Scale adjoyning conſiſteth (as you ſee) of 12 feet in all, 11 thereof are marked with figures downwards, beginning at 1, 2, 3, 4 and ſo to 11: the firſt at the top is ſub-divided into inches by diagonal lines, as the diſtance between the firſt line of the Scale and the firſt diagonal line is one inch, the ſecond is 2, and the third 3 inches, and ſo to Six. The way to demonſtrate the Scale, you ſee, is very eaſie: Draw Seven lines parallel to each other, and of what length you pleaſe, to retain what number of Feet you pleaſe, then beginning at the top, ſet off with the compaſſes



the

the length of your Feet both allow and aloft, then draw lines thwart the parallel lines, to every foot of the Scale, and ſet numbers to them, beginning at the ſecond foot 1, and to the third 2, to the fourth 3, and ſo forward, leaving the firſt Foot to be divided into Inches by the Diagonall lines, as you ſee in the foregoing Scale.

CHAP. III.

Concerning the drawing your Draught upon Paper.

HAving fitted your Scale ready, draw a line to repreſent the Keele of the Ship, as you ſee in the draught following of 60 foot long by the Keele, and 20 foot broad: the ſtreight line that repreſenteth the Keele is marked with A B. Then draw a line underneath of equall length to ſignifie the bottome of the Keele. Then next you may proceed to the Stern-poſt, as the line A C will ſignifie the foreſide or the inſide thereof, racking the one quarter of his length aft, and for the length of the Stern-poſt it muſt be directed to the built of the Ship, as whether ſhe be to be a deep Ship or a ſhallow Ship, ſo that the draught of the water ought to be reſpected firſt, and then the lying of the Ports for the convenience of Ordnance, for that the upper tranſome of the Buttock, commonly is juſt under the Gun-Room ports, to the upper edge of the ſaid tranſome we underſtand the length of the Stern-poſt, although if the Stern-poſt were continued to the height of the Tiller, and another Tranſome ſtard there for the Tiller to run on, it would ſteady the quarters of the Veſſel very much, and do good ſervice.

The

The Stern-poſt being drawn, we may proceed to draw the Stem, which in the following Draught is not ſo much racked as was the old proportion of *England*, which was the whole breadth of the Ship, for then it ſhould be 20 foot, but it is no more then 15 foot, juſt $\frac{1}{4}$ of the breadth, for too much racke with the Stem doth a great deale of damage to any Ship, if we conſider that in this ſmall Veſſel, had we given 5 foot more Racke, all the weight of the Ships Head, and Boltſpreet, Foremaſt, Manger, Halſps, Breſt-hooks aloft, had been ſo much farther forward, where there would have been want of Bodie to lift it, ſo that it muſt of neceſſity be detriment to the Veſſel when ſhe ſaileth againſt a head ſea, and a great ſtrain to her. Now it will be very good to ſpend as much of this racke as we can under the water, for it will help the Ship to keepe a good Winde, by giving her ſomething more Body in the water.

Next draw the Water-line, in the following draught ſignified by the pricked line; it is drawn to 9 foot height afore, and to 10 foot height abaft from the upper edge of the Keele, and higher abaft then afore, for the moſt Ships ſaile by the Sterne, and alſo for that the Guns ſhould lie ſomething higher abaft then afore from the water.

Then proceed to hanging of the Waals, and here you ſee the lower Waalle drawne from the head of the Sterne-poſt, to ſignifie that it ſhould lie againſt the end of the Tranſome, that the Tranſome Knees might be bolted to the Waals without board to one foot and an halfe under the Water-line, a little before the middle of the Water line, and at 9 foot high on the Stem, and the next Waale parallel to the lower Waale, one foot and an half aſunder, ſo that the upper Waale will lie juſt at the waters edge, in the mid-ſhips, the upper edge of the Gun-deck will lie one foot aboye the water line abaft, and halfe a foot above water on the Stem;

ſo,

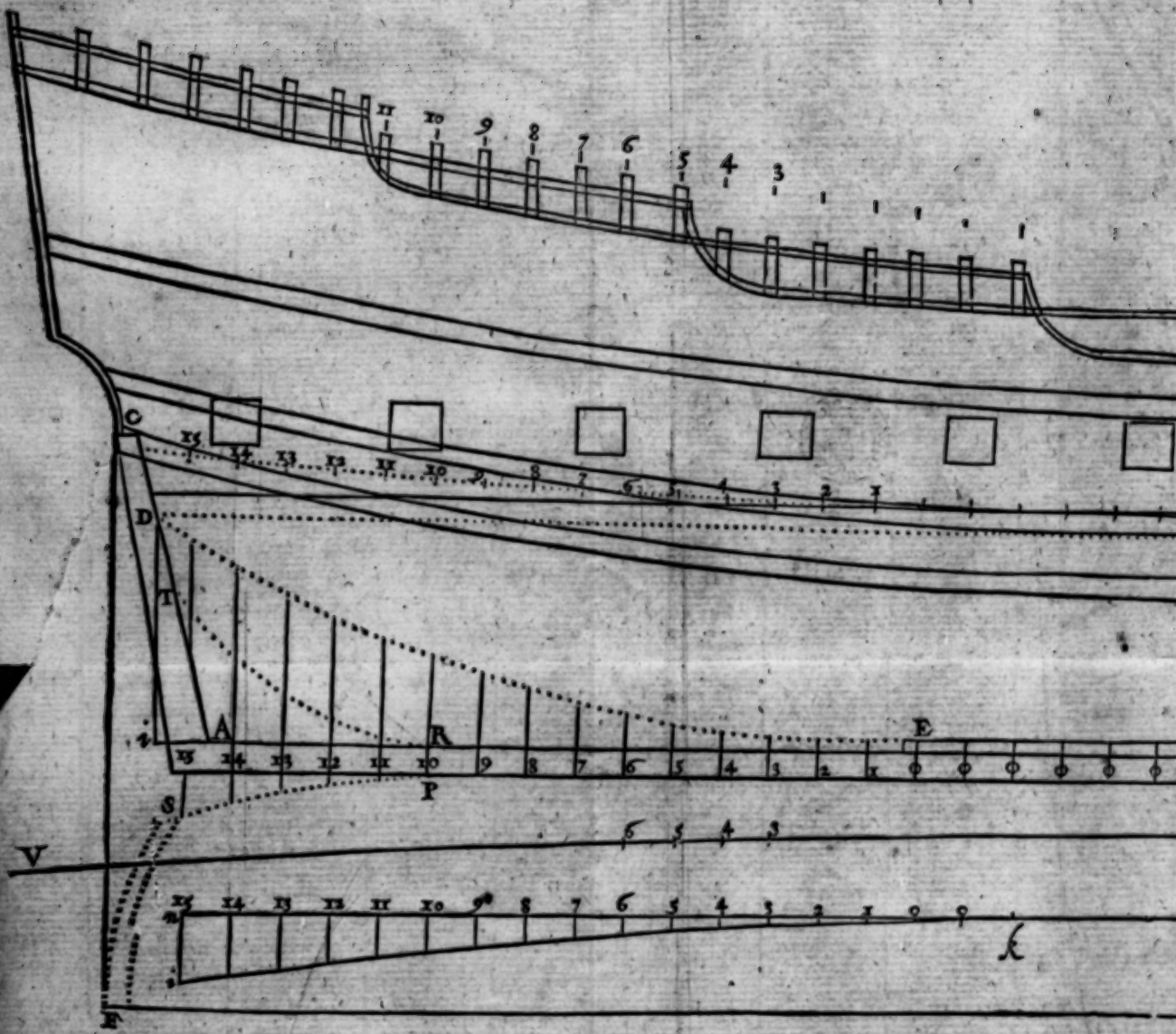
ſo then letting the lower fell of the Ports be two foot from the Gun-decks, the lower edge of the Ports wil be three foot from the water abaft, and two foot and an halfe afore, in the middle of the Gun-deck 2 foot 9 inches, ſufficient for ſo ſmall a Veſſel, a greater Veſſel would require to have the Guns ſomething farther from the water, then if another Waale be required, firſt ſet off the Ports in their places, that the Waale may ly above the Ports, or elſe he would be cut with the ports in pieces, the upper Deck with height reſpecting the bigneſſe of the Ship, having reſpect to not over building ſmall Ships, to damage their bearing of Sail.

Then for the Head, the length of the Knee would be two thirds of the breadth, ſo then the Knee of the Head in this Draught will be 12 foot 8 inches long, and for his place, as low as conveniently he can, provided that the Rails of the Head, fall not fowl of the halſhols, becauſe that in placing of the Knee low, giveth room to round the Head, and ſteeve it to content: The place of the Knee will be at, or very neer, the upper Waal, the upper edge of the Knee againſt the upper edge of the uper harping, which will be very well for the lower Cheeks of the head to be faced againſt, for by that means they wil be clear of any Seame to avoid Leakings, and will very well bolt the end of the harping, if a Breſt-hook be faſtned alſo within board againſt them, will very well faſten all together.

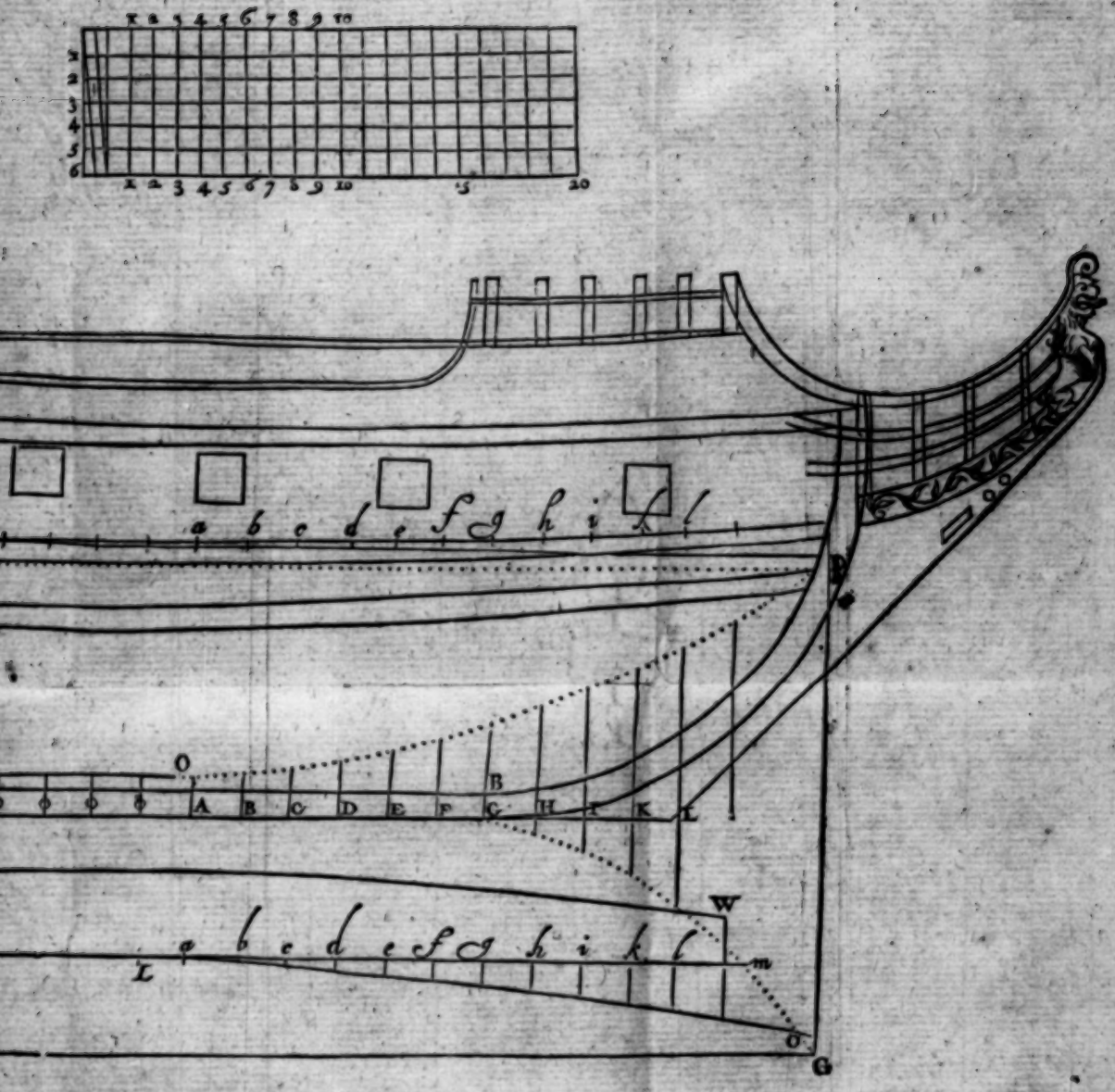
Then for the ſteeving of him, and rounding the Knee, a regard muſt be had to the lying of the Boltſpreet, leaving room enough for the Lyon and Scrowl under the Boltſprit. Then for the rounding of the Rails, round them moſt at the after ends.

For the heights between Decks and Steeridge, Cabine, Fore-Caſtle, thoſe heights are commonly mentioned in contract by the Maſter or Owners building.

CHAP.



Place this Draug



raught at Page 8

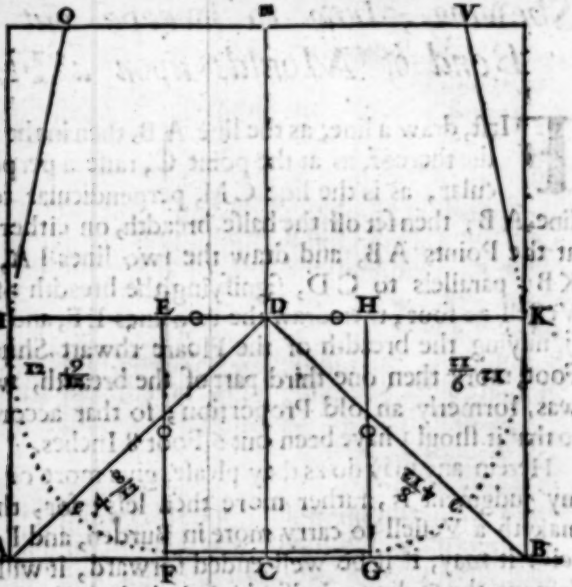
CHAP. IV.

Shewing, how to ſweepe out the Bend of Moulds upon a Flat.

FIrſt, draw a line, as the line A B, then in the middle thereof, as at the point C, raiſe a perpendicular, as is the line C M, perpendicular to the line A B; then ſet off the halfe breadth, on either ſide, at the Points A B, and draw the two lines I A, and K B, parallels to C D, ſignifying the breadth of the Veſſell 20 foot; then draw the two lines E F, and H G, ſignifying the breadth of the Floare thwart Ships, 8 Foot, more then one third part of the breadth, which was formerly an old Proportion; ſo that according to that it ſhould have been but 6 Foot 8 Inches.

Herein any may do as they pleaſe, give more or leſs; my judgment is, rather more then leſs: for, that it maketh a Veſſell to carry more in Burden, and I conceive it may, if it be well ended forward, it will not damage the ſayling: I alſo think, it doth ſtiffen a Veſſell on this account. Our *Engliſh* Veſſells have been uſed to have their breadth lying at the height of the Halfe Breadth, then obſerving ⅓ breadth for the length of the Floare Thwart Ships, it maketh the Veſſells Body to be very neare a Circle, as is a Cask, which cauſeth ſuch Veſſells to be eaſie to ſlew in the Water; yet I would not exceed neither, or run into extreams herein, but if I were to make a Veſſell ſtiff, I would that

the Halfe Breadth be more then the draught of Water, which causeth that the Body be stronger in the Water, and will not Slew so easily. Now to sweep out the Sides under Water, I draw the *Diagonall* lines D A,



and D B; then I divide the *Diagonall* lines into 9 parts, and set off 2 of them from the Corners A and B, to the points *e*, then I set off the Dead Rising, which is 4 Inches, one Inch to a Foot, for halfe the breadth represented in the Figure above, by the little line parallel to F G; from which Dead Rising, take with the Compasses the Distance that will draw a piece of an Arch from *f* to *e*, and so as one foot of the Compasses

ſes ſtand in the line E F, and exactly touch the points at the Dead-Riſing, at *f* or *g*, and touch alſo the points *e*, over which point falls at ⊙, in E F, or ⊙ in H G, wherewith I deſcribe the Arch *e* F, or *e* G, which is by the Scale in the Draught 4 Foot 8 Inches: then for the other part of the Side upwards, ſeek for a Point in the breadth line I K, at which, if one foot of the Compaſſes be ſet, and the other foot opened to the Extreame Breadth, will alſo draw, or ſignifie an Arch to meet with the other Lower Arch, on the *Diagonall* line at *e*, which is at the points ⊙ and ⊙; thus the point ⊙, between D and K, neere H, Sweepeth the contrary Side I *e*, and ſo the point ⊙, between D I, neere E, Sweepeth the contrary ſide at K; extend the ſame Sweepe alſo above the Breadth line above Water 3 or 4 Foot, the length of this Sweepe is 12 Foot 9 Inches: then ſet off the Tumbling Home, at the Height of the two firſt Haanſes, at the Maine Maſt and Foarcaſtle, 2 foot of a ſide; then draw a line from the ſaid 2 Foot of Narrowing, at the points *o v*, till it break off on the back of the Sweep, on either ſide. This kinde of Demonſtration I conceive moſt ſuitable to our following diſcourſe of *Arithmeticall* Work, I could have cited other wayes, but I judge this way ſufficient.

CHAP. V.

The Description of the Rising Lines aftward on, and forward on; with the Narrowing Lines, and Lines of Breadth: As also the Narrowing Lines at the top of the Timbers.

DRaw a Hanging line on the Draught, from the Keele, from the middle of the Keele to the height of the Water line, on the Post which will be the Rising line, as the line D E; this line D E is supposed to be sweept, or drawn by a *Semidiameter* of a Circle, extended on a Perpendicular raised at the point E, for if it be shorter then such a *Semidiameter* of the true Circle, it will make a fuller line then it should be, and so must not be so long, or else it will make a breach at the beginning of the line; this, if the Centre be supposed to be Abaft such a Perpendicular, that should draw a Rising line Abaft, I say, that it will shorten the Rising line, and make it fuller then it should be; or then if it be farther forward, it will be straighter then a Circle, and also be a breach at the beginning of the Rising line; therefore it should be a Circle, I say, whose *Semidiameter* will be on the Perpendicular line, at the beginning of any such Rising line, on the Heele, either Afoare, or Abaft,

Abaft, and the like ought to be for all other crooked lines, as the narrowing lines Abaft, or Afoare, or at the Narrowing of the Floare, or other Circular lines, as Hanging of Waals, and the like; the way whereof I ſhall deſcribe, to finde the lengths of all ſuch Sweeps by Arithmetick; as alſo the true Riſing, Narrowing of any Timber, according to exact peeces of Circles, very uſefull for the ſetting of Bows, to trie whether they hang to a true Sweepe or no: I ſhall demonſtrate it, I ſay, in the following diſcourſe, and in this place end what I intend to ſay. For Demonſtration then, At ½ of the Keele forward I draw a Riſing line forward to the height of the Water line, forward on the Stemm, as you ſee the line *o p*: and the little line, between theſe two lines, parallel to the inſide of the Keele, marked *E o*, is the dead riſing 4 inches high, as in the bend of Moulds it is parallel to F G, the height of the breadth from the Mid-Ship forward is the lower Edge of the upper Waale; but afterward on it is the pricked line, between the Water line and the lower Waale, on the Poſt, which runneth forward to the edge of the Waale, and hath Figures ſet to it, to ſignifie the places of the Timbers marked 1, 2, 3, 4, 5, to 15.; as you ſee anſwers to the Figures on the Keele: and the Letters ſet to forward on, ſignifie the places of the Timbers forward, marked A B C D to L, in the middle of the Veſſel: the places marked with a Cipher ſignifie the Flats, which have onely Dead riſing, although they ought to have, ſome of them, ſomething more Dead riſing then each other; and thoſe that have leaſt, to be placed in the middle of the reſt, that ſo there be no Clings in the Buldge, but that it have alſo a little Hang-

ing in it, it will ſeeme the fairer: Then I draw a ſtraight line, parallel to the bottome of the Keele, as is the line F G, parallel to the line A B, the Keele, and diſtant 10 foot by the Scale, which is the halfe breadth of the Veſſell; for this line ſignifieth a line ſtretched from the middle of the Sterne-Poſt to the middle of the Stem, called by *Ship-wrights*, a Ram-line: Parallel to this Middle line I draw another line ſtraight, marked *n m*, and is 4 foot aſunder from the Middle line, to ſignifie the halfe length of the Floare thwartſhips, as in the Bend of Moulds E F is diſtant from D C 4 Foote: then I draw a Crooked line Abaft, within this line *n m*, to ſignifie the narrowing of the Floare, to bring, or forme the Veſſells way Abaft, as you ſee the line *i k*; Abaft and Afoare it is repreſented by the line *l o*: then here in this Draught I draw a Sweepe, or a piece of a Circle, from the point G, the marke of the Timber G, on the Keele, to the halfe breadth of the Stemm, to the point G on the Stemm, ſignifying the Sweep of the Harping, and is Sweept by the breadth of the Veſſell 20 Foot; the piece of the Pricked Circle Abaft at the Starne, which is drawn by a Centre on the line F G, is the length of the Tranſom thwart the Starne, as is the Arch F S, the length whereof is 8 Foot, which doubled is 16 Foot, for the whole length: which is $\frac{4}{5}$ of the breadth 20 Foot, the length of the Sweepe that ſweepeth it is the length of the Starnpoſt to the bottome of the Keele 14 Foot $\frac{1}{2}$, then the Crooked line, from the end of the Tranſom, or from the point S, and toucheth the Keele at the point *p*: this Arch S *p*, is the narrowing line Abaft at the breadth, and the Crooked pricked line within the Keele, marked with T R, is a

Riſing

Riſing line, to order a hollow Moulde by the Timbers, are placed at 2 Foot Timber and Roome, as you may ſee by the Scale, the line drawne from the Poope to the Foar-Caſtle, marked by the letters V W, is a line ſignifying the breadth of the Veſſell, at the top of the ſide, from the top of the Poope to the Fore-Caſtle, the top of the Poop is in breadth 10 Foot, halfe the breadth at the beame, the uſe of this line is in ordering of the Moulds, to ſtedy the Head of the Top-Timber Mould, to find his breadth aloft.

CHAP. VI.

Shewing the Making and graduating, or marking of the Bend of Molds.

REpaire to ſome Houſe that hath ſome Roome or other broad enough to demonſtrate the breadth of the Veſſell, and height enough for the top of the Poope in the length of the Roome; or elſe if you cannot finde ſuch a Roome conveniem, lay boards together, or planks, that may be large enough for your buſineſs, as in the following *Schaame* you ſee; Firſt, a long ſquare made for the breadth of the Veſſell; as in the following Figure I A B K: then make the Moulds by their Sweepes, and make Sirmarks to them for the laying of them together in their true places, off firſt the Mould, for the Floare being made; you may make a Sirmarke by the line E F, on the head of the

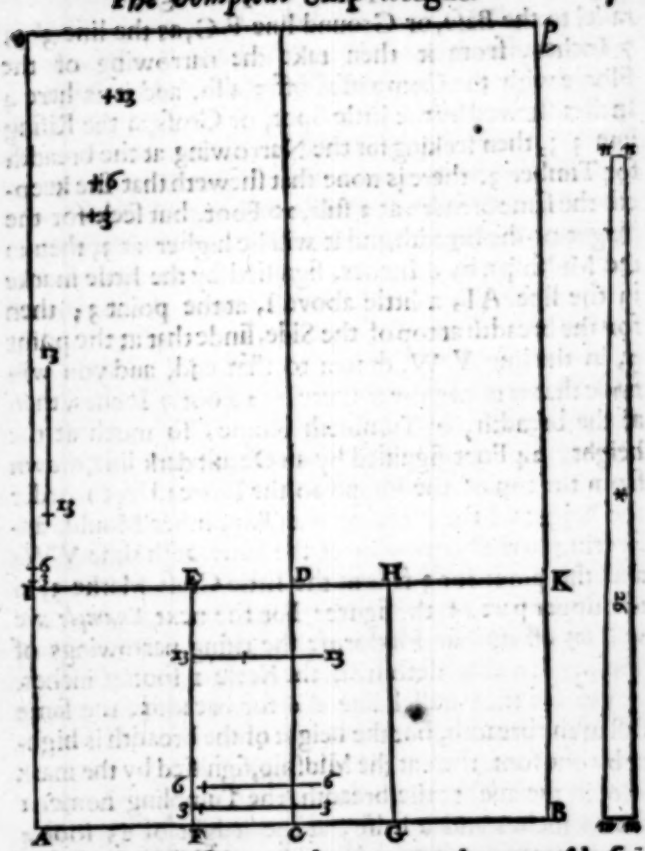
Floare

Floare Mould, and another on the foot of the Navill Timber Mould, at the ſame place, to ſignifie, that thoſe two marks put together, they are in their true places, and will compare ſo when any Timbers are Molded by them: thoſe Sirmarks muſt alſo be marked off on the Timbers, and ſo in putting the Timbers up in the frame, a regard being had to compare Sirmarks with Hirmarks, each Timber will finde his own place, and come to his own breadth, and give the Veſſell that forme aſſigned her by your *Draught*, if it be wrought by it, and ſo for all the other Moulds.

In making your Moulds, that they may be ſmaller and ſmaller upwards, and not all of a bigneſs, you may meaſure the depth of the Side in the Mid-Ships Circular, as it goeth from the Keele to the top of the Side, as here the Side, as it Roundeth, is 26 foot, and in depth at the Rounheads, or at the end of the Floare, is one Foot, as *m m*; and at the other end, at the head of the Timber is but halfe a Foot, as at *n n*, ſo then drawing two lines, as the lines *n m*, repreſents the diminiſhing of the Moulds in thickneſs upwards, as thoſe two lines repreſenteth; as if you would finde the thickneſs of the Timbers at the breadth, take your 2 Foot Rule, and meaſure the length from the end of the Floare at the point F to I, at the breadth in the crooked body, and it is 11 Foot 9 Inches, ſignified at the Sirmarks there, thoſe two lines ſhew the thickneſs to be 9 Inches; and ſo thick ought the Moulds to be at the breadth of the Veſſell.

By this Proportion the Moulds being made and Sirmarked to the body of the Veſſell, and that they muſt be marked, or ordered, to finde the decreaſe of her bulks

body



body in the Midſhips, and to come to her way Abaft, that the Water may paſs to her Rudder to make her Stere, repaire to the *Draught*, and firſt ſet off her Riſings thus; *Example*, We will begin at Timber 3 Abaft, and his Riſing is 7 inches: therefore draw a line pa-

rallel to the Baſe, or Ground line F G, as the line 3 3. 7 Inches, from it then take the narrowing of the Floare with the Compaſſes off 3 alſo, and it is here 4 Inches, ſhewed by the little Spot, or Croſs, in the Riſing line 3 3, then ſeeking for the Narrowing at the breadth for Timber 3, there is none that ſheweth that ſhe keepeth the ſame breadth at 3 ſtill, 20 Foot, but ſeek for the height of the breadth, and it will lie higher at 3, then in the Midſhips, by 6 Inches, ſignified by the little marke in the line A I, a little above I, at the point 3; then for the breadth at top of the Side, finde that at the point 3, in the line V W, drawn to that end, and you will finde that it is narrower there by 2 Foot 7 Inches, then at the breadth, or Tumbleth Home, ſo much at the height, 24 Foot ſignified by an Occult dark line, drawn from the top of the Poope to the Foarcaſtle, to order the height of the Head of the Toptimber Mould, anſwering to the Narrowing of the ſame, at the line V W; and this point for 3 falls at the little Croſs Marke 3, in the upper part of the figure: For the next *Example* we will ſet off on our Platforme the riſing narrowings of Timber 6, and 6 riſeth from the Keele 1 foot 7 inches, as you ſee the parallel line 6 6 for breadth, the ſame ſtill at the breadth, but the height of the breadth is higher by one foot, then at the Midſhip, ſignified by the mark at 6, in the line: at the breadth, the Tumbling home, 1 foot 7 inches and a halfe, at the height of 25 foot 4 inches, at the point 6, and ſo proceed of all the reſt, beginning alone, till you come aft to the faſhion Pieces; when you have ſet off all the heights of Riſings, narrowings of the Floare, narrowings of the Breadth, height of the Breadth, at the Breadth of the Veſſel,

and

and alſo of the Head of the Toptimber: Then at each point of the *Floare*, ſtill in a Naile, or a Gimblet, or ſome ſuch thing, as ſuppoſe we begin here at 3, ſtick one in the Midſhip line at 3, another in the little Croſs, at the narrowing of the Floare at 3; another at the height of the Breadth at 3; another at the little croſs, at the head of the Toptimber for 3, then if you have a lower Futtocke Mould, and an upper futtocke Mould, otherwiſe a navell Timber Mould, and a futtocke Mould, naile them together with ſmall Nailes, and lay the Sirmarks of the floare Mould, and futtock Mould to the Gimblet that ſticketh at the ſhortning of the floare; for by this meanes the floare Mould and futtock Mould is hauled downward: then make a mark at the croſs, in the Midſhip line CD, ſetting to the marke of 3 for Timber 3, which will be the ſhortning of the Floare; then be ſure the Navell Timber Moulds touch the Gimblet at the breadth, and at the narrowing of the floare, keeping the lower Sirmark thereto; and make a marke on the *Futtocke* Mould, at the upper Gimblet, for the riſing alow lifteth up the Moulds higher; and if there be any Croſſing at the foot of the Navell Timber, and Head of the *Floare* Mould, marke it, and ſet to the marke 3 to it, that you may know to lay them together again, and keeping the *Futtocke* Mould faſt, lay to the Toptimber Moulde the breadth Sirmarke of the Toptimber Moulde, to the Gimblet at the breadth, ſo have you no more Sirmarkes on the Toptimber Moulde but one, and guide the head of him till a line ſtretched from the Croſs, at the head of the Toptimber, till it compareth with the right part of the Toptimber Mould, then regard the Croſſing of the

foot of the Toptimber Mould, and the back of the futtocke, and marke it, ſetting to the proper Marke 3 to it, that laying thoſe markes together again, they may finde their own places again, ſo having finiſhed for this Roome 3, take up the Moulds, and remove the Gimblets to the next, as to 6, here in our *Example*, and ſtick the Gimblets at all the markes of 6, then lay down the Mouldes again, laying down the floare Moulde to the Sirmarke of 6, on the narrowing of 6, and to the Gimblet, ſticking on the Midſhip line of D C, and right on the ſame line, at the croſſing, make a marke on the floare Mould, which will be the narrowing of the floare; then lay down the futtocke Mould, the Sirmarke on the foot to the Gimblet, on the narrowing of the floare, and keeping the Mold to touch the Gimblets at both places, make a marke for the breadth Sirmarke at 6, on the futtoke Mould, and ſet to 6; then lay down the Toptimber Mould, the breadth Sirmarke thereof to the Gimblet, ſticking at the height of the breadth, that the backſide of the uper end may randge faire, by a right line from the croſs at the uper end of the Toptimber at 6, by the back of the Toptimber Mould, a ſtraight line may compare therewith; then keeping faſt the Mouldes ſo till you have marked the croſſing of the foot of the Toptimber Mould, by the back of the futtocke, marke it on the foot of the Toptimber Mould, and ſet to the marke of 6, ſo that when you are in any other place, as in the Woods a hewing of a *Frame*, where you to every place his Timber, you may be able to lay your Moulde together, and moulde it according to your *Draught*: We will lay down the taking of one bend of Timbers moreafte,

moreafte, where the breadth is narrowed, as at Timber 13, take his riſing off, and meaſure it by the Scale, and it will be 6 foot 8 inches, which ſet off on your Plat-forme, and draw thereto a Parallel line, to the Ground line A B, as is the line 13 13, then take off the narrowing of the floare, as at 13, it is 2 foot 2 inches; ſet that off on the line 13, from the line *E F*, as at the little croſs thereon, then take off the narrowing of the Breadth at 13, and it will be 8 inches; draw therewith a little parallel line, parallel to I O, as is the parallel line 13 13, then ſeek the height of the breadth, as at 13, it will be from the uper edge of the Keele 12 foot 3 inches, and croſſes the parallel line, at the lower end of it, juſt then for the tumbling of the Top-timber it will be 3 foot 3 inches, and at the height of 27 foot 7 inches, at the little Croſs 13: Now for the order of the hollow Mould, the little round piece of an Arch, in the Scegg of the Veſſell, as it were, take off all the Riſings, and mark them on the Riſing Staffe, on one edge, that they may be known from the other Riſings; as here, for Timber 13, take off the hollow Riſing, which will be at 1 foot 10 inches, ſet it off on the riſing Staff, at 1 foot 10 inches from one end, and the uſe of it will be in Moulding, ſet off the height of this hollow Riſing on the middle line of the Timber, when the Mouldes are laid to paſs, and ſtrike a line from this Riſing, on the middle line, untill it break off on the back of the Moulds, then lay the hollow *M*ould to the lower part of the britch of the Timber, and at the halfe breadth of the Keele, and ſo bear in the other end till it juſt touch the ſtreight line, made by the hollow Riſing, and the back of the *M*oulds, and this mouldeth the

lower

lower part, or britch of the Timber, and bringeth in the hollow very faire; the ſame orders may be obſerved afoare, as abaft, on the other ſide of the Moulds, and marked with letters, to be known from them abaft: Then for the height of your Waals, you may marke a marke at every third or fourth Timbers, which you reſolve to make frame Timbers; I ſay, you may make a marke at every third or fourth Timber, for the height of the upper edge, or lower edge of the Waale, and ſo bring on the Waale fair by thoſe markes on the one ſide, and with a level finde the height of the other ſide by the former.

Now I have briefly touched the Demonſtration of a *Ship*, by Projection, I ſhall now come to an *Arithmeticall* way, farr ſurpaſſing any Demonſtration for exactneſs.

CHAP. VII.

Arithmetically ſhewing how to frame the body of a Ship *by Segments of Circles: being a true way to examine the truth of a Bow.*

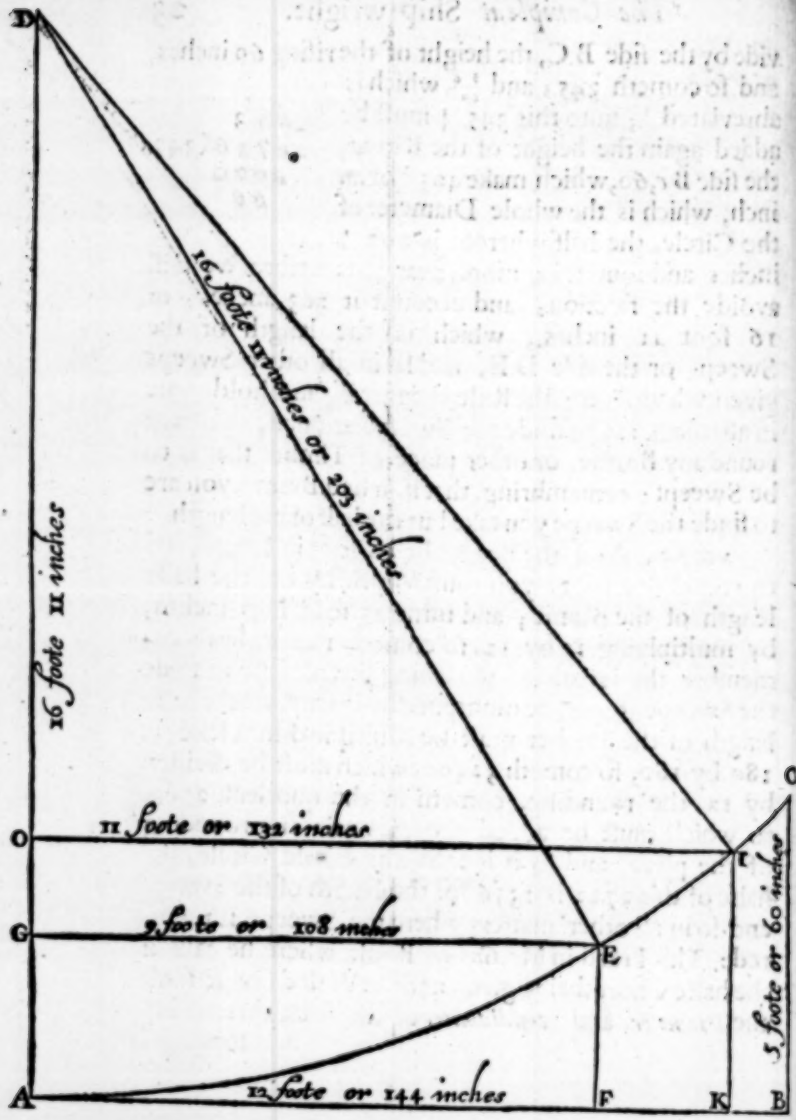
LEt AB repreſent the length of a Riſing line 12 foot long, or 144 inches, the height whereof let be BC, 5 foot, or 60 inches, to finde the ſide DE, or DA, the radius of the circle AC, whereto AD is the Semidiameter; multiply the ſide AB 144 inches in it ſelf, and ſo cometh 20736, which ſum divide

144
144
576
576
144
20736

vide by the ſide B C, the height of the riſing 60 inches, and ſo cometh 345, and $\frac{1}{60}$, which is abreviated '; unto this 345 ' muſt be added again the height of the Riſing, the ſide B *e*, 60, which make 405 ' of an inch, which is the whole Diameter of the Circle, the half whereof is 202 $\frac{1}{2}$ inches, and ſomething more, near $\frac{1}{4}$, therefore we will avoide the fraction, and account it 203 inches, or 16 foot 11 inches, which is the length of the Sweep, or the ſide D E, and ſo in all other Sweeps given whatſoever; the Rule is generall, and holds true in all things: as to finde the Sweepe at once, that will round any Beame, or other piece of Timber that is to be Sweept; remembring, that if it be a Beame, you are to finde the Sweepe you take but the half of his length.

23(3
20736(345
6000
66

Example, As if the Beame be 30 foot in length, and to round one foot, you muſt Work by 15, the halfe length of the Beame; and turne 15 foot into inches, by multiplying 15 by 12, ſo cometh 180 inches: remember the length of the Riſing line, if it be to finde the Sweepe, it muſt be multiplied by it ſelfe, or the halfe length of the Timber muſt be Multiplied in it ſelfe, as 180 by 180, ſo cometh 32400, which muſt be divided by 12 the rounding, cometh in the quotient 2700, to which muſt be added the 12 again, the rounding of the piece, and ſo it is 2712 the whole Circle, the halfe of this 2712 is 1356 for the length of the Sweep, and ſo in all other matters where the Sweepe is required: This I read in Mr. *Gunters* Book, where he calls it the halfe Chord, being given, and the Verſed fine, to finde the *Diameter*, and *Semidiameter* of the circle thereto belonging:


D
16. foote 11 inches
16. foote 11 inches or 203 inches
O
11. foote or 132 inches
G
9. foote or 108 inches
C
E
5. foote or 60 inches
A
12. foote or 144 inches
F
K
B

longing: Now this half Chord in our Work is the length of the Riſing line, and the height of the Riſing on the Poſt is that in our Work, which he repreſents by the name of the Verſed ſine, where remember to multiply the length of the Riſing line by it ſelf, if it be a Riſing line, and divide by the height of the Riſing, and to the diviſion add again the height of the Riſing, ſo have you alwayes the whole Circle, divide it by 2, ſo have you the length of the Sweepe.

Example in the *Draught* foregoing.

Where the length of the Riſing line is from the point E, to the point *i*, 32 foot; and half the height thereof is the line D *i*, 10 foot: turne both Summs into inches, as 32 foot multiplyed by 12 produceth, adding the $\frac{1}{2}$ foot 6 inches, 390 inches length for the Riſing line: then turn the height of the Riſing into inches, as 10 foot multiplied by 12, produceth 120 inches, from which 4 inches muſt be ſubſtracted, becauſe of the dead Riſing is 4 inches, ſo then the height is 116 inches: Now multiply the length 390 inches by it ſelf, 390 maketh 152100.

```
  390
  390
 ----
  000
 3510
 1170
-----
152100
```

This Multiplication of the ſumm 152100, muſt be divided by 116 inches, the height of the Riſing, and ſo cometh in the quotient of the deviſion 1311 inches; unto this 1311 inches, muſt be added the 116 inches, the height of the Riſing $\frac{1}{14}\frac{1}{17}$, and it maketh 1427, which is the whole

```
x x 2
3 3 x 3
4 6 3 44
x 5 x x 0 8 (1311
x x 6 6 6
8 x x x
x x
```

Circle: divide it by 2, to finde the half of it, ſo have you in the quotient 713 inches ½ inch for the length of the Sweep, which divided by 12, to bring it into feet, maketh 59 feet, 5 inches and a halfe, and ſo for all other Circular lines whatever, when the length is known, and the rounding of them alſo known; as for the hanging of Waals, the height of them known in the Midſhips from the Keele, ſubſtracted from the height, at the Poſt, and that will be the hanging of them, which is the ſame with the height of the Riſing line on the Poſt, in the *Arithmeticall* Work, and is the ſame with the Verſed ſine in *Geometry*; theſe I think Examples ſufficient, to ſignifie the Conſtruction of this way of Working by Sweepes.

2 1427 (713
2 2 2

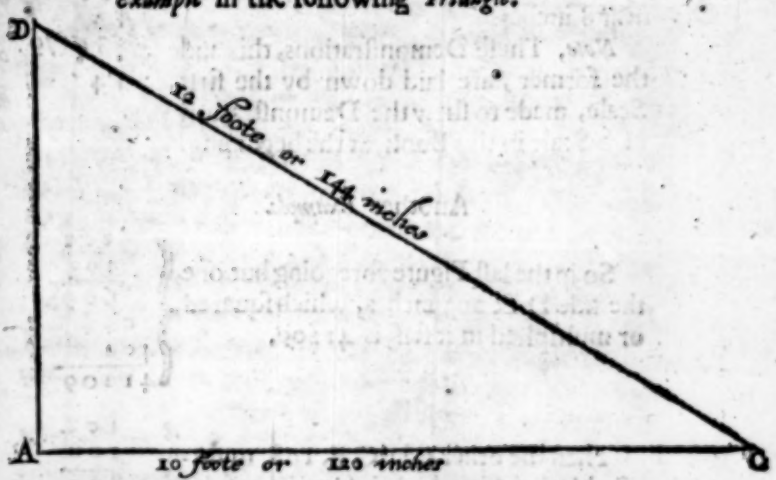
It followeth now that I ſhew the manner of finding the Riſings of Timbers by *Arithmetick* alſo.

To finde the Riſing of the line F E, *in the Figure foregoing.*

The Sweepe being firſt found to be as before 203 inches, as the ſide D E ſignifieth, then there is known the ſide E G, 108 inches; now theſe two ſides being given, we are to finde the third ſide D G, ſo here is made a right Angled Triangle, two ſides thereof are given to finde a third, which to do, proceed thus; Multiply the two ſides given by themſelves, and ſubſtract the Multiplication of the ſhorteſt ſide, from the Multiplication made of the other ſides, and extract the ſquare Root of the remainder, ſo have you the third ſide ſought for.

Example

Example in the following *Triangle.*



Having the ſide D C, 12 foot, which is 144 inches; and the ſide A C, 10 foot, otherwiſe 120 inches; to finde the ſide D A, multiply the ſides given, in themſelves, which is called ſquaring of them: as, multiply the ſide D C, 144 inches, by 144 inches, ſo cometh 20736. Then multiply the other ſide A C 120 alſo by it ſelf, ſo cometh in the quotient 14400, which muſt be ſubſtracted from the other Multiplication, as you ſee, ſo cometh in the quotient 6336, from which the greateſt ſquare muſt be extracted, called extraction of the ſquare root,

144
144
576
576
144
20736
120
120
000
240
120
14400
20736
14400
6336

which is 79 inches, and almoſt another by the Fraction, that is 6 foot, and very near 8 inches.

Note, Theſe Demonſtrations, this and the former, are laid down by the firſt Scale, made to ſhew the Demonſtration of a Scale in this Book, at the beginning.

x
595
147
6336(79
14

Another *Example.*

So in the laſt Figure foregoing but one, the ſide D E, 203 inches, which ſquared, or multiplied in it ſelf, is 41209.

203
203
609
000
406
41209

Then the other ſide G E, 108, multiplied in it ſelfe, which is ſquaring of it, is 12664, as you ſee.

108
108
864
000
168
11664

Which ſubſtracted from the other multiplication, as 11664 ſubſtracted from 41209, reſteth 29545, the ſquare Root extracted from it, or the ſide of the greateſt ſquare that can be taken from the ſubſtraction being found, is 171, and $\frac{1}{4}$; which 171 $\frac{1}{4}$, ſubſtracted from 203, the length of the Sweepe for one ſide, is alwayes the length of the Sweepe, reſteth 31 inches $\frac{1}{4}$, for the Riſing of the line E F, and the like for any other Riſing.

41209
11664
29545
(3
256(08
29545(171
2.
34

Another

Another *Example.*

As at the place K I, the Riſing thereof is required, the ſide D I is as D E, 203 inches.

Note, The length of the Sweepe being found, alwayes is one of the ſides, in the finding the Riſing of any Timber, and is alwayes one of the numbers, which when you have ſquared, note in a piece of Paper by it ſelf, where you may alwayes ſee what it is, ſo that in the finding of Riſings, after the Sweepe is found, all you have to do, is to know how many feet, or inches, the Timber you ſeek for is removed from the beginning, or foot of the Riſing line, which is the ſecond ſide, and in this third *Example* it is 11 foot, or 132 inches K I, from the foot of the line A, which ſquared, is 17424, which muſt be ſubſtracted from the ſquare made of Radius, which in the other example is 41209, and ſo reſteth 23775, from which extract the ſide of the Square therein contained, and it is 154 inches and ½, which ſubſtracted from the length of the Sweep, leaveth 48 inches for the Riſing, and ½ inches, or 4 foot, and ½ of an inch, and ſo much is the Riſing of the ſaid Timber.

132
132
264
396
132
17424

41209
17424
23773

20
23769
23789(154
20
3

One *Example* in the *Draught*, The length of that Sweepe we found heretofore to be 713 inches, then we

will

will ſeek to finde the Riſing for Timber 13, ſtanding aft from the point E, or foot of the Riſing line 324 inches, theſe are the given Sides, then proceed; ſquare the Semidiameter of the Sweepe 713, ſo it maketh ſquared 508363; then ſquare the diſtance of the Timber 13, which is 324, and it maketh 104976; theſe ſubſtracted from the former figures, reſteth 403387, the ſquare Root thereof is 635 ½, neareſt, which ſubſtracted from the Radius 713, reſteth 77 inches and ½, that is 6 foot 5 inches, which with 4 inches Dead Riſing, is 6 foot 9 inches ½; and ſo much is the Riſing of Timber 13 from the Keele.

I ſuppoſe theſe *Examples* are ſufficient to illuſtrate the truth and plainneſs of this *Arithmeticall* Work, for the truth of it; it hath this to ſay for it ſelf, that it is the very exact truth it ſelf: The great *Objection* may be, that many know not the way to Extract the Square Root, and therefore cannot attaine to this Work, by reaſon of that let, or hinderance.

To this I Anſwer, There are many Books that will inſtruct thee in it, that thou mayeſt buy, or borrow; but to anſwer thee better, I will briefly ſhew thee the manner of Extracting the Square, not doubting but thou canſt performe Addition, Subſtraction, Multiplication, and Diviſion already.

CHAP.

CHAP. VIII.

How to Extract the Square Root.

KNow then that a ſquare number hath its ſides equall every way, as are the ſides of 4, repreſented by :: pricks; and you ſee that every way of all the 4 ſides it containeth 2, and ſo 2 times 2, make 4, which is the ſquaring of a number, ſo you ſee ::: 9 pricks is a ſquare, or 9 is a ſquare number, whoſe ſide is 3, and 3 times 3 make 9, but 2 times 3 is not a ſquare number, as you ſee :::, being but 2 one way, and the other way 3, that make but 6; ſo then all the numbers between 4 and 9, are not ſquare numbers: by the like reaſon, a ſquare, made of the Next ſquare number 4 is 16, for 4 times 4 is 16, as by the Pricks you may ſee it repreſented here, every of the 4 ſides containing 4, make a ſquared number of 16, and all the numbers that are between 9 and 16, as 2 times 4, or 3 times 4, are not ſquares, but have a fraction annexed to them; ſo alſo any number betwen 16 and 25, are not ſquares, as 4 times 5, or 2 times 5, or 3 times 5, theſe are not ſquare numbers, but 5 times 5 is a ſquared number, and maketh 25, where note, that to ſquare a number, and to extract the ſquare root, is two different things; for when we ſay, to ſquare a number, is to multiply it in it ſelf, or by it itſelfe; or when





when we ſay, or ſpeake of a number ſquared, it is a number multiplied in it ſelf, but to extract the ſquare Root, is to finde the ſide of the ſquare in a number given, or the extracted ſquare Root is the ſquare Root found in any given number.

Thus you may conceive of the Squares of 6, for 6 times 6 make 36; 7 times 7 make 49; 8 times 8 make 64; 9 times 9 make 81; 10 times 10 make 100: there is all the ſquares made of the 9 Figures, expreſſed by this little Table annexed, as againſt each Figure is the ſquare made of them, as 2 times 2 is 4, ſo is 4 againſt 2, as you ſee.

1	1
2	4
3	9
4	16
5	25
6	36
7	49
8	64
9	81
10	100

Now to extract the ſquare Root from greater numbers, as from 144 proceed thus, write downe the ſumme given, as followeth, and make a quotient on the right hand, as you ſee, then ſet pricks under every other figure beginning at the right hand, and ſet pricks towards the left hand, under every other figure, ſo in this number 144, conſiſting of 3 figures, there is 2 pricks, and ſo many figures muſt the quotient conſiſt of; then begin at the left hand of the ſumm, and ſay, or enquire for the greateſt ſquare in the figure, or figures, over the firſt prick, at the left hand, which here is but 1, therefore you can take but 1, for 1 is alwayes the Square, or Cube of 1, therefore write 1 in the quotient, and ſubſtract that 1 from the 1 over the left hand prick, and

```
144 (
 .  .
 0
144 (1
 .  .
```

and Caneell it, nothing remainining, write a Cipher over it, as you ſee, ſo have you one figure of the quotient, then double your figure found in the quotient, as 2 times 1 is 2; write that 2 under the figure between the next prickes, which is the Diviſor for the ſecond figure, then ſay, how many times 2 can
I have in 4, over the Diviſor, I ſay 2, 0 0 0
therefore I write 2 in the quotient, 1 4 4 (12
ſaying, 2 times 2 is 4, which ſubſtract 2
from the 4 over head, Cancell the
Diviſor, and the 4 over head, and write a Cipher over it, then ſquare the laſt figure found in the quotient, ſaying, 2 times 2 is 4, which ſubſtract from the 4 over the prick, and ſo reſteth 0, therefore cancell the 4, and write Ciphers over head, ſignifying, that the number given to finde the roote of, is a juſt ſquare number, the roote or ſide is 12, the proofe hereof is by Multiplication of the quotient in it ſelf, as 12 by 12 make 144, which, if it be the ſame with the ſumm given to be Extracted, it is rightly done; if it do not agree, it is not true.

Example of another *Summ.*

Let 625 be given to finde the Square Root of it, write down the ſumm, make a quotient, and ſet pricks under every other figure; then enquire
for the greateſt ſquare in the figure, 2
over the pricke, at the left hand; I ſay, 6 2 5 (2
2 is the greateſt ſquare can be taken:
for 3 times 3 is 9, and here the figure is but 6; ſo I write 2 in the quotient, and ſquare it, ſaying, 2 times 2 is 4, taken from 6, ſo reſteth 2; I cancell the 6, and write 2

over it, as you ſee; then double the figure in the quotient, ſaying, 2 times 2 is 4; this 4 is the ſecond Diviſor, I write it between the two next pricks, and ſay, how many times 4, can I have in 22, and I finde 5 times; for 5 times 4 is 20, taken from 22, the figures over 4, ſo reſteth 2; therefore I write 5 in the quotient, and ſaying, 5 times 4 make 20; therefore I cancell the 4 Diviſor, and the 22, and write 2 overhead, then ſquare the laſt figure found, 5 by 5 make 25, taken from 25 over head, reſteth nothing, ſo the number given is a ſquare number.

2	
625 (2	
4	
22	
625 (25	
4	
22	
625 (25	
4	

A Summ of 5476, given to finde the neareſt Square-Root in it, write down the Summ, and make a quotient, and prick underneath, as afore ſhewed; ſay, What is the greateſt Square in the figures over the left hand prick, and I finde it to be 7, for 7 times 7 make 49, but 8 times 8 make 64, 10 too much, therefore I write 7 in the quotient, and take 7 times 7, that is 49 from 54, ſo reſteth 5, which I write over the prick, and Cancell the 5 and the 4; then I double the figure in the quotient, which maketh 14, for the Diviſor, I write the firſt figure of the Diviſor, if there be more then 1 under the figure, between the two next pricks, and all the other figures, in their places, toward the left hand; then inquire how many times can 1 be taken from 5, overhead, and I finde it may be taken 4 times; I write therefore 4 in

5	
5476 (7	
49	
1	
91	
5476 (74	
14	

in the quotient, and ſay, 4 times 1 is 4, from 5; ſo reſteth 1: I Cancell the 1 and the 5, and write 1 over the 5, then I ſay, 4 times 4 make 16, from 17 reſteth 1: I Cancell the 4 Diviſor, and write 1 over 7, and Cancell the other 1 and the 7; then I ſquare the laſt figure found, for ſo it muſt be at every prick, 4 times 4 make 16, which I ſubſtract from the 16 over the laſt prick, and ſo I ſee nothing remaineth, that ſheweth the ſum given, to be a juſt ſquare ſumm.

10
5 2 0
5 4 7 6 (74
2 4

Example of another *Summ.*

As if 528563 be given to finde the greateſt ſide of the Square therein, I write down the Summ, as followeth, and make the quotient, and ſet the pricks under every other figure, as you ſee; and ſeeing there is 3 pricks, it telleth, that there muſt be 3 figures in the quotient, then beginning at the figures over the left hand pricke, I take the greateſt ſquare in 52, and I finde it 7, for 7 times 7 make 49; therefore I write down 7 in the quotient, and Subſtract 49 from 52, ſo reſteth 3, therefore Cancell the 52, and write 3 over the 2, as you ſee; then double the quotient 7, it maketh 14, for a new Diviſor, which write down, the firſt figure thereof, under the figure between the two next pricks, namely 4 under 8, and the other figure of the Diviſor one place farther to the left hand, under the 3, as you ſee; then take the Diviſor 1 as many times as you can, from the fi-

3
5 2 8 5 6 3 (7
1 4

gure 3 over head, ſo as that after the Diviſion be made, there may be the ſquare of the laſt figure of the quotient, taken from the figures over the next prick, as I can take 1 but 2 times from 2, therefore I write 2 in the quotient, and Cancell the Diviſor 1, ſaying, 2 times 1 is 2, from 3; ſo reſteth 1: I Cancell the figure 3 alſo, and write 1 overhead, as you ſee: then 2 times 4 is 8, from 8 over head reſteth nothing; therefore I Cancell the ſecond figure of the Diviſor, 4 and 8, and write a Cipher over 8, as you ſee; then the next place being a prick, I muſt ſquare the laſt figure found, ſaying, 2 times 2 make 4, from 5; the figure over the prick reſteth 1, as you ſee; therefore I Cancell the 5, and write 1 over it, as you ſee, and here is a fraction of 101.

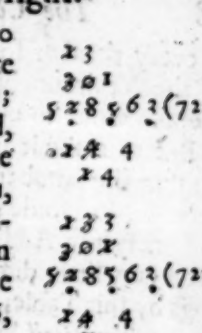
```
  1
  3 0
  5 2 8 5 6 3 (72
    1 4
  1
  3 0 1
  5 2 8 5 6 3 (72
    1 4
```

Then for a new Diviſor, Double the quotient 72, and it makes 144, which is a new Diviſor, the firſt figure thereof write under the figure between the next pricks, as the firſt 4 under 6, in the ſumm; and the other figures towards the left hand, in the order as you ſee: then, how many times 1 in 10 over head, and I ſee I cannot take 8 times, for that there will not be left to take out the other figures from, nor for the ſquare of the laſt figure, which if it were 8, would be 64 from the figure over the pricke, therefore I take but 7, for by a light examination I ſee that will doe, therefore I write down 7 in the quotient, and proceed to the

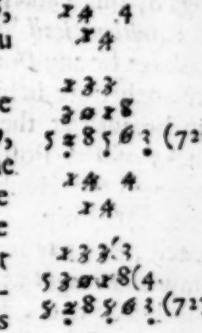
```
  1
  3 0 1
  5 2 8 5 6 3 (727
    1 4   4
      1 4
```

Diviſion.

Diviſion, thus, 7 times 1 is 7, from 10 over head remaineth 3, which I write down, and Cancell the 10, as you ſee; then 7 times 4 is 28, from 31 over head, ſo remaineth 3, which I alſo write down, and Cancell the 31; then again, 7 times 4, the other figure of the Diviſor, is alſo 28, which taken from 36 over head, reſteth 8, which I write down over 6, and ſo Cancell the 36, and then the Suum ſtandeth as you ſee.



Then laſtly, ſquare the laſt figure of the quotient, 7 times 7 make 49, taken from 83, the figures over the prick, reſteth 34, as a fraction, and the Summ is finiſhed: But in regard here is a fraction, by that it tells you, that the Summ given was no ſquare number; and the greateſt ſquare therein is 727, the proofe is by Multiplication adding in the fraction thus, 727 Multiplied by 727, make 528529, then adding in the fraction of 34, maketh it 528563, the juſt Summ given.



But ſome may Object, and ſay, That this is a very tedious way of Work, and will take up a great deale of time; It is true, it is more labour then demonſtration, but the truth of it might very well plead for patience to Work it, but it is not neceſſary you performe all the parts by it, that is, in every particular: as the exact hanging of the Waal at every Timber, but it may ſuffice

at every third or fourth Timber, to finde the hanging of the Waals, onely the Riſings alow, afoare and abaft, I would work to every Timber there.

But to make it more briefe, here followeth a Table that the numbers are therein contrived to the ſame purpoſe, to avoide the tedious Extraction of the Root, and onely uſe Addition and Subſtraction, onely being but a very little difference between the finding the Riſings by this Table, and by the *Draught*, for in this kinde of *Arithmeticall* Work, it mattereth not, whether or no there be any *Draught* drawn at all, or no, if the builder onely note in his Book the length by the Keele, and the breadth at the Beame, the Racke of the Stem, Racke of the Poſt, depth of the Water, to Sayle in depth of the Hould, height of the Waals abaft, afoare, at the Midſhips, and all the remarkable things to be noted, he may be able to Build a Veſſell, and never draw a *Draught* at all, and yet affirm his Worke to be abſolutely true, according to Art, and a great deale more exact then by *Draught*: I ſhall in few words ſhew you the uſe of the Table, and ſo conclude.

CHAP.

CHAP. IX.

A Deſcription of the Table of Squares.

TO ſave the Practitioner a labour of Extracting of Roots, for here they are ready done to thy hand of purpoſe, and all the uſe of *Arithmetick* required is onely Subſtraction, as *Example* in the Figure of the Sweep foregoing, being found to be 203 inches, as you ſaw it found before, which is, I ſay, alwayes one ſide of the Triangle, made of the ſide DI, then knowing the length of ◦I, 132 inches, which is the diſtance of the point, of which the Riſing is ſought at; ſeek in the Tables, under the Title of inches, at the head of the Tables, for 132, you will finde it in the ſecond Page, and the twelfth line; and right againſt it, in the ſame line, under the next Title of Squares, you have 17424, the ſquare made of 132, which Subſtract from the Square made of 203, which is 41209, which is found in the ſecond Page of the Tables, and the third line: Now the other number 17424, Subſtracted from 41209, ſo reſteth 23775; ſeek the number neareſt to it in the Table, under the Title of Squares, which you will finde in the ſecond Page, 34 line, you finde not juſt the ſame number, for in ſtead of 23775, you finde 23716 too little by 59, and the Root anſwering thereto, is in the ſame line, under the Title of inches, towards the left hand,

hand, which is 154; now if you take the next ſquare lower to the left hand 35 line, it is 24025, 250 too much, ſo you may ſee it is nearer to the 34th line, becauſe there it was too little but by 59, ſo that you may ſee it will be ¼ of an inch leſs then the number of inches, belonging to the 35th line, and about ¾ of an inch more then the numbers in the 34th line; ſo that you ſee it is anſwered, the third ſide D *o* is 154, and ¼ of an inch, which Subſtracted from the whole Sweep 203, leaveth 48 ¾ inches for the Riſing, ſo you have no need of extraction of the Rootes by theſe Tables, it is already done to your hand; the Columne that is between the inches and the ſquares, and written feet inches in the head, is to ſhew you, how may feet, and inches of the foot any number of inches is; as here, the number 203 inches ſought, and found in the Tables, in the ſecond page, and third line, juſt againſt it, in the ſame line, between that and the ſquares, is 16---11, ſhewing that it is 16 feet and 11 inches; or if the ſquare were given, as 41209, found at the ſecond page, and third line, next toward the left hand, you have 16 foot, 11 inches; and if you ſeek for it in inches, in the third Columne toward the left hand, and the ſame line, you have 203 inches: Thus is it very ready to reduce inches into foot meaſure, or feet into inches.

Another *Example.*

In the ſame figure, to finde the Riſing at the point *F*, the ſweep being 203 inches, as before is ſaid, is alwayes one ſide, throughout the whole Work of the ſame Riſing line is 41209, as is found in the ſecond page, the third

third line; the other ſide from the point A to F, is 9 foot, or 108 inches, whoſe ſquare is 11664, found in the firſt page, and the 28th line; now ſubſtract the ſquare made of the ſide A F, 11664, from the ſquare of the ſide D E, ſo remaineth 29545

41209	
11664	
29545	

Seek in the Table of ſquares for that number, and I finde in the ſecond page, and 12 line, and the ſixth Columne, 29584, the neareſt number to it, yet it is a little too much near the $\frac{1}{4}$ of an inch; and toward the left hand in the ſame line, the next Column under the title *feet inch*, you finde 14; 4 ſignifying that to be 14 foot, 4 inches: and in one Columne more to the left hand, and the ſame line, you ſee under the Title of *inches* 172 over the head you tituled *Inches*, which muſt be ſubracted from 203 inch, ſo remaineth 3 inches for the Riſing of F E, which is 2 foot, 7 inches, as in the firſt page of the Table, and the 31 line.

203	
172	
031	

Theſe few *Examples* I think may be ſufficient to ſhew the uſe of the following Tables of ſquares, the benefit whereof may be very great, for ſuch as ſhall make uſe of the ſame: If any deſire the finding of the Fractions of theſe ſquares, when he findeth not his juſt figures in the ſquares, let him do thus, ſubſtract the Figures under his number, from the Figures above his number, which ſhall be the denominator, then theſe Figures given, ſubſtracted, from which the next ſquares leſs, ſhall be the denominator to that Fraction.

As for *Example*, In the foregoing figures, after ſubſtraction, ſhould have been 29553; the neareſt agreeing in the Tables, is 29584, the next leſſer ſquare number in the Table is 29241, which is more a great deale too lit-

tle, then the other is too great; then ſubſtract the leſſer ſquare number 29241, from 29584, and ſo reſteth 343, which muſt be the denominator, then again ſubſtract the true number given, 29553, the next leſſer ſquare number in the Table is 29241, which muſt be ſubſtracted, I ſay, from the true number given, 29553, and ſo reſteth after ſubſtraction 312, which is the Numerator to the Fraction, and muſt be thus written, $\frac{m}{343}$, ſo then the number belonging to 29584, is 171 inches, and $\frac{312}{343}$ parts of an inch, which being abreviated, is ſomething more then $\frac{1}{4}$ of one inch, and not full $\frac{3}{4}$ of one inch.

	29584
	29241
	343

Thus he that pleaſeth may finde the riſing of any Timber, or narrowing of any place by theſe Tables and the help of Subſtraction, exactly to any Circle whatſoever, but it may ſuffice, that a Man, going to his Tables, may ſee which ſquare his figures have greateſt affinity with, and may eſtimate the difference near enough, without ſeeking for the fraction, which will be eaſily known by much practiſe herein.

Here followeth a Table *of* Square Roots, *ready Extracted, from one Inch to* 1300 *Inches, which is to* 108 *foot, and* 4 *Inches, and it is thus contrived, That from one Inch, to* 840 *Inches, all the Inches are reduced into Feet and Inches, for the eaſe and help of Workmen, who alway take their Meaſures by Feet and Inches; but from thence to the end of the Table you have the Inches onely, and the Squares thereof againſt them as the Titles over every Page do make appear.*

Inch	Feet	Inches	Squares	Inch	Feet	Inches	Squares	Inch	Feet	Inches	Squares
1		1	1	41	3	5	1681	81	6	9	6561
2		2	4	42	3	6	1764	82	6	10	6724
3		3	9	43	3	7	1849	83	6	11	6889
4		4	16	44	3	8	1936	84	7	00	7056
5		5	25	45	3	9	2025	85	7	1	7225
6		6	36	46	3	10	2116	86	7	2	7396
7		7	49	47	3	11	2209	87	7	3	7569
8		8	64	48	4	00	2304	88	7	4	7744
9		9	81	49	4	1	2401	89	7	5	7921
10		10	100	50	4	2	2500	90	7	6	8100
11		11	121	51	4	3	2601	91	7	7	8281
12	1	00	144	52	4	4	2704	92	7	8	8464
13	1	1	169	53	4	5	2809	93	7	9	8649
14	1	2	196	54	4	6	2916	94	7	10	8836
15	1	3	225	55	4	7	3025	95	7	11	9025
16	1	4	256	56	4	8	3136	96	8	0	9216
17	1	5	289	57	4	9	3249	97	8	1	9409
18	1	6	324	58	4	10	3364	98	8	2	9604
19	1	7	361	59	4	11	3481	99	8	3	9801
20	1	8	400	60	5	00	3600	100	8	4	10000
21	1	9	441	61	5	1	3721	101	8	5	10201
22	1	10	484	62	5	2	3844	102	8	6	10404
23	1	11	529	63	5	3	3964	103	8	7	10609
24	2	00	576	64	5	4	4096	104	8	8	10816
25	2	01	625	65	5	5	4225	105	8	9	11025
26	2	2	676	66	5	6	4356	106	8	10	11236
27	2	3	729	67	5	7	4489	107	8	11	11449
28	2	4	784	68	5	8	4624	108	9	0	11664
29	2	5	841	69	5	9	4761	109	9	1	11881
30	2	6	900	70	5	10	4900	110	9	2	12100
31	2	7	961	71	5	11	5041	111	9	3	12321
32	2	8	1024	72	6	00	5184	112	9	4	12544
33	2	9	1089	73	6	1	5329	113	9	5	12769
34	2	10	1156	74	6	2	5476	114	9	6	12996
35	2	11	1225	75	6	3	5625	115	9	7	13225
36	3	00	1296	76	6	4	5776	116	9	8	13456
37	3	1	1369	77	6	5	5929	117	9	9	13689
38	3	2	1444	78	6	6	6084	118	9	10	13924
39	3	3	1521	79	6	7	6241	219	9	11	14162
40	3	4	1600	80	6	8	6400	120	10	0	14400

Inch	Feet	Inches	Squares	Inch	Feet	Inches	Squares	Inch	Feet	Inches	Squares
121	10	1	14641	161	13	5	25921	201	16	9	40401
122	10	2	14884	162	13	6	26244	202	16	10	40844
123	10	3	15129	163	13	7	26569	203	16	11	41209
124	10	4	15376	164	13	8	26956	204	17	00	41616
125	10	5	15625	165	13	9	27225	205	17	1	42025
126	10	6	15876	166	1310		27556	206	17	2	42436
127	10	7	16029	167	1311		27889	207	17	3	42849
128	10	8	16384	168	1400		28224	208	17	4	43264
129	10	9	16641	169	14	1	28561	209	17	5	43681
130	10	10	16900	170	14	2	28900	210	17	6	44100
131	10	11	17161	171	14	3	29241	211	17	7	44521
132	11	00	17424	172	14	4	29584	212	17	8	44944
133	11	1	17689	173	14	5	29929	213	17	9	45369
134	11	2	17956	174	14	6	30276	214	17	10	45796
135	11	3	18225	175	14	7	30625	215	17	11	46224
136	11	4	18496	176	14	8	31076	216	18	0	46656
137	11	5	18769	177	14	9	31329	217	18	1	47089
138	11	6	19044	178	1410		31684	218	18	2	47524
139	11	7	19321	179	1411		32041	219	18	3	47961
140	11	8	19600	180	1500		32400	220	18	4	48400
141	11	9	19881	181	15	1	32761	221	18	5	48841
142	11	10	20164	182	15	2	33124	222	18	6	49284
143	11	11	20449	183	15	3	33489	223	18	7	49729
144	12	00	20736	184	15	4	33856	224	18	8	50176
145	12	01	21025	185	15	5	34025	225	18	9	50625
146	12	2	22416	186	15	6	34596	226	18	10	51076
147	12	3	21609	187	15	7	34969	227	18	11	51529
148	12	4	21904	188	15	8	35344	228	19	0	51984
149	12	5	22201	189	15	9	35721	229	19	1	52441
150	12	6	22500	190	1510		36100	230	19	2	52900
151	12	7	22801	191	1511		36481	231	19	3	53361
152	12	8	23104	192	1600		36864	232	19	4	53824
153	12	9	23409	193	16	1	37249	233	19	5	54289
154	12	10	23716	194	16	2	37636	234	19	6	54656
155	12	11	24025	195	16	3	38025	235	19	7	55225
156	13	00	24336	196	16	4	38416	236	19	8	55696
157	13	1	24649	197	16	5	38809	237	19	9	56069
158	13	2	24964	198	16	6	39204	238	19	10	56644
159	13	3	25381	199	16	7	39601	239	19	11	57121
160	13	4	25600	200	16	8	40000	240	20	0	57600

Inch.	Feet	Inches	Squares
241	20	1	58081
242	20	2	58564
243	20	3	59049
244	20	4	59536
245	20	5	60025
246	20	6	60516
247	20	7	61009
248	20	8	61504
249	20	9	62001
250	20	10	62500
251	20	11	63001
252	21	0	63504
253	21	1	64009
254	21	2	64516
255	21	3	65025
256	21	4	65536
257	21	5	66049
258	21	6	66564
259	21	7	67081
260	21	8	67600
261	21	9	68121
262	21	10	68644
263	21	11	69169
264	22	0	69596
265	22	1	70425
266	22	2	70756
267	22	3	71289
268	22	4	71824
269	22	5	72361
270	22	6	72900
271	22	7	73441
272	22	8	73984
273	22	9	74529
274	32	10	75076
275	22	11	75575
276	23	0	76176
277	23	1	76729
278	23	2	77284
279	23	3	77841
280	23	4	78400
281	23	5	78961
282	23	6	79524
283	23	7	80089
284	23	8	80656
285	23	9	81225
286	23	10	81796
287	23	11	82369
288	24	0	82944
289	24	1	83521
290	24	2	84100
291	24	3	84681
292	24	4	85264
293	24	5	85849
294	24	6	86436
295	24	7	87025
296	24	8	87616
297	24	9	88209
298	24	10	88804
299	24	11	89401
300	25	0	90000
301	25	1	90601
302	25	2	91204
303	25	3	91809
304	25	4	92416
305	25	5	93025
306	25	6	93636
307	25	7	94241
308	25	8	94864
309	25	9	95481
310	25	10	96100
311	25	11	96721
312	26	0	97344
313	26	1	97969
314	26	2	98596
315	26	3	99225
316	26	4	99856
317	26	5	100489
318	26	6	101124
319	26	7	101761
320	26	8	102400
321	26	9	103041
322	26	10	103684
323	26	11	104329
324	27	0	104976
325	27	1	105625
326	27	2	106276
327	27	3	106929
328	27	4	107584
329	27	5	108241
330	27	6	108900
331	27	7	109561
332	27	8	110224
333	27	9	110889
334	27	10	111556
335	27	11	112225
336	28	0	112896
337	28	1	113569
338	28	2	114244
339	28	3	114921
340	28	4	115600
341	28	5	116281
342	28	6	116964
343	28	7	117349
344	28	8	118336
345	28	9	119025
346	28	10	119716
347	28	11	120409
348	29	0	121104
349	29	1	121801
350	29	2	122505
351	29	3	123206
352	29	4	123909
353	29	5	124604
354	29	6	125311
355	29	7	126025
356	29	8	126736
357	29	9	127449
358	29	10	128164
359	29	11	128881
360	30	0	129600

Inch.	Feet	Inches	Squares	Inch	Feet	Inches	Squares	Inch.	Feet	Inches	Squares
361	30	1	130321	401	33	5	160801	441	36	9	194481
362	30	2	131044	402	33	6	161604	442	36	10	195364
363	30	3	131769	403	33	7	162409	443	36	11	196249
364	30	4	132496	404	33	8	163216	444	37	0	197136
365	30	5	133225	405	33	9	164025	445	37	1	198025
366	30	6	133956	406	33	10	164836	446	37	2	198916
367	30	7	134689	407	33	11	165649	447	37	3	199809
368	30	8	135424	408	34	0	166464	448	37	4	200704
369	30	9	136161	409	34	1	167281	449	37	5	201601
370	30	10	136900	410	34	2	168100	450	37	6	202509
371	30	11	137640	411	34	3	168921	451	37	7	203401
372	31	0	138384	412	34	4	169744	452	37	8	204304
373	31	1	139129	413	34	5	170569	453	37	9	205209
374	31	2	139876	414	34	6	171396	454	37	10	206116
375	31	3	140625	415	34	7	172225	455	37	11	207025
376	41	4	141676	416	34	8	173056	456	38	0	207936
377	31	5	142129	417	34	9	173889	457	38	1	208849
378	31	6	142984	418	34	10	174724	458	38	2	209764
379	31	7	143641	419	34	11	175561	459	38	3	210681
380	31	8	144400	420	35	0	176400	460	38	4	211600
381	31	9	145161	421	35	1	177241	461	38	5	212521
382	31	10	145924	422	35	2	178084	462	38	6	213444
383	31	11	146689	423	35	3	178959	463	38	7	214369
384	32	0	147456	424	35	4	179776	464	38	8	215296
385	32	1	148225	425	35	5	180625	465	38	9	216225
386	32	2	149006	426	35	6	181476	466	38	10	217156
387	32	3	149769	427	35	7	182329	467	38	11	218089
388	32	4	150544	428	35	8	183184	468	39	0	219024
389	32	5	151321	429	35	9	184041	469	39	1	219961
390	32	6	152210	430	35	10	184900	470	39	2	220900
391	32	7	152881	431	35	11	185761	471	39	3	221841
392	32	8	153664	432	36	0	186624	472	39	4	222784
393	32	9	154449	433	36	1	187489	473	39	5	223729
394	32	10	155236	434	36	2	188356	474	39	6	224676
395	32	11	156025	435	36	3	189225	475	39	7	225625
396	33	0	156816	436	36	4	190096	476	39	8	226576
397	33	1	157609	437	36	5	190960	477	39	9	227429
398	33	2	158104	438	36	6	191044	478	39	10	228484
399	33	3	159201	439	36	7	192721	479	39	11	229141
400	33	4	160000	440	36	8	193600	480	40	0	230400

Inch	Feet	Inches	Square	Inch	Feet	Inches	Square	Inch	Feet	Inches	Square
481	40	1	231361	521	43	5	271441	561	46	9	314721
482	40	2	232324	522	43	6	272448	562	46	10	315844
483	40	3	233289	523	43	7	273529	563	46	11	316969
484	40	4	234256	524	43	8	274576	564	47	0	318096
485	40	5	235225	525	43	9	275625	565	47	1	319225
486	40	6	236196	526	43	10	276676	566	47	2	320356
487	40	7	237169	527	43	11	277729	567	47	3	321489
488	40	8	238144	528	44	0	278784	568	47	4	322624
489	40	9	239121	529	44	1	280241	569	47	5	323761
490	40	10	240100	530	44	2	280900	570	47	6	324900
491	40	11	240981	531	44	3	281961	571	47	7	326041
492	41	0	2420 4	532	44	4	284 24	572	47	8	327184
493	41	1	243049	533	44	5	2870 9	573	47	9	328329
494	41	2	244036	534	44	6	285156	574	47	10	330276
495	41	3	245025	535	44	7	286225	575	47	11	330625
496	41	4	246016	536	44	8	287296	576	48	0	331776
497	41	5	246509	537	44	9	288369	577	48	1	332929
498	41	6	247004	538	44	10	290444	578	48	2	384048
499	41	7	249001	5 9	44	11	290521	579	48	3	335241
500	41	8	250000	540	45	0	291600	580	48	4	336400
501	41	9	251001	541	45	1	292681	581	48	5	337561
502	41	10	251004	542	45	2	293764	582	48	6	338724
503	41	11	253009	543	45	3	294849	583	48	7	340089
504	42	0	254016	544	45	4	295936	584	48	8	341056
505	42	1	255025	545	45	5	297025	585	48	9	342225
506	42	2	256036	546	45	6	298016	586	48	10	343396
507	42	3	257049	547	45	7	299209	587	48	11	344669
508	42	4	258064	548	45	8	300304	588	49	0	345744
509	42	5	269081	549	45	9	301401	589	49	1	346921
510	42	6	260100	550	45	10	302500	590	49	2	348100
511	42	7	261121	551	45	11	303601	591	49	3	349281
512	42	8	262144	552	46	0	304704	592	49	4	350464
513	42	9	263169	553	46	1	305809	593	49	5	351649
514	42	10	264196	554	46	2	306916	594	49	6	352836
515	42	11	265225	555	46	3	308025	595	49	7	353025
516	43	0	266256	556	46	4	309136	596	49	8	354216
517	43	1	267289	557	46	5	310249	597	49	9	355409
518	43	2	268324	558	46	6	311364	598	49	10	356604
519	43	3	269361	559	46	7	312481	599	49	11	358801
520	43	4	270400	560	46	8	313600	600	50	0	360000

Inch	Feet	Inches	Squares	Inch.	Feet	Inches	Squares	Inch	Feet	Inches	Squares
601	50	1	361201	641	53	5	410881	681	56	9	463761
602	50	2	362404	642	53	6	412164	682	56	10	465124
603	50	3	363609	643	53	7	413449	683	56	11	466489
604	50	4	364816	644	53	8	414736	684	57	0	467856
605	50	5	366025	645	53	9	416025	685	57	1	469225
606	50	6	367236	646	53	10	417316	686	57	2	470596
607	50	7	368449	647	53	11	418609	687	57	3	471939
608	50	8	369664	648	54	0	419904	688	57	4	473344
609	50	9	370881	649	54	1	421201	689	57	5	475721
610	50	10	372100	650	54	2	422500	690	57	6	476700
611	50	11	373321	651	54	3	423801	691	57	7	477841
612	51	0	374544	652	54	4	425104	692	57	8	478864
613	51	1	375769	653	54	5	426403	693	57	9	480269
614	51	2	376996	654	54	6	427716	694	57	10	481636
615	51	3	378225	655	54	7	429025	695	57	11	482825
616	51	4	379456	656	54	8	430336	696	58	0	484416
617	51	5	380689	657	54	9	431449	697	58	1	485809
618	51	6	381924	658	54	10	432969	698	58	2	487204
619	51	7	383161	659	54	11	434181	699	58	3	488601
620	51	8	384400	660	55	0	435600	700	58	4	490000
621	51	9	385641	661	55	1	436921	701	58	5	491401
622	51	10	386884	662	55	2	438244	702	58	6	492804
623	51	11	388129	663	55	3	439569	703	58	7	494209
624	52	0	389376	664	55	4	440896	704	58	8	495616
625	52	1	390625	665	55	5	442225	705	58	9	497025
626	52	2	391876	666	55	6	443556	706	58	10	498436
627	52	3	393129	667	55	7	444889	707	58	11	498849
628	52	4	394384	668	55	8	446224	708	59	0	501264
629	52	5	395641	669	55	9	447561	709	59	1	502681
630	52	6	396900	670	55	10	448900	710	59	2	504100
631	52	7	398161	671	55	11	450241	711	59	3	505521
632	52	8	399424	672	56	0	451544	712	59	4	506944
633	52	9	400489	673	56	1	452829	713	59	5	508669
634	52	10	401956	674	56	2	454276	714	59	6	509796
635	52	11	403225	675	56	3	455625	715	59	7	511225
636	53	0	404496	676	56	4	456976	716	59	8	512656
637	53	1	405769	677	56	5	458229	717	59	9	514089
638	53	2	407044	678	56	6	459684	718	59	10	515824
639	53	3	408321	679	56	7	461041	719	59	11	516961
640	53	4	409600	680	56	8	462400	720	60	0	518400

Inch	Feet Inch	Squares	Inch	Feet Inch	Squares	Inch	Feet Inches	Squares
721	60 1	519841	761	63 5	579121	801	66 9	641601
722	60 2	521284	762	63 6	580644	802	66 10	643204
723	60 3	522729	763	63 7	582169	803	66 11	644809
724	60 4	524176	764	63 8	583696	804	67 0	646416
725	60 5	525625	765	63 9	585225	805	67 1	648025
726	60 6	526976	766	63 10	586756	806	67 2	649836
727	60 7	528529	767	63 11	588289	807	67 3	651249
728	60 8	529984	768	64 0	589824	808	67 4	652864
729	60 9	521421	769	64 1	591361	809	67 5	654481
730	60 10	522900	770	64 2	592900	810	67 6	656100
731	60 11	524361	771	64 3	594441	811	67 7	657721
732	61 0	535844	772	64 4	595984	812	67 8	659344
733	61 1	537289	773	64 5	597529	813	67 9	660969
734	61 2	538656	774	64 6	599076	814	67 10	662596
735	61 3	540225	775	64 7	600625	815	67 11	664225
736	61 4	541696	776	64 8	602176	816	68 0	665856
737	61 5	543169	777	64 9	604729	817	68 1	667489
738	61 6	544644	778	64 10	606284	818	68 2	669124
739	61 7	546031	779	64 11	607841	819	68 3	671761
740	61 8	547600	780	65 0	608400	820	68 4	672400
741	61 9	549081	781	65 1	609961	821	68 5	674041
742	61 10	550564	782	65 2	611524	822	68 6	675684
743	61 11	552049	783	95 3	613099	823	68 7	677329
744	62 0	553436	784	65 4	614656	824	68 8	678976
745	62 1	555025	785	65 5	616225	825	68 9	680625
746	62 2	556516	786	65 6	617796	826	68 10	682276
747	62 3	558009	787	65 7	619369	827	68 11	684129
748	62 4	559504	788	65 8	620944	828	69 0	685584
749	62 5	561001	789	65 9	622521	829	69 1	688241
750	62 6	562500	790	65 10	624100	830	69 2	688900
751	62 7	564001	791	65 11	625681	831	69 3	689661
752	62 8	565504	792	66 0	627964	832	69 4	692224
753	62 9	567009	793	66 1	628849	833	69 5	693889
754	62 10	568516	794	66 2	630466	834	69 6	695556
755	62 11	570025	795	66 3	632125	835	69 7	697225
756	63 0	571536	796	66 4	633616	836	69 1	698896
757	63 1	573049	797	66 5	635209	837	69 9	700569
758	63 2	574564	798	66 6	637404	838	69 10	702244
759	63 3	576081	799	66 7	638401	839	69 11	703921
760	63 4	577600	800	66 8	6			

Inch	Squares	Inch	Squares	Inch	Squares	Inch	Squares
841	707281	881	777161	921	847241	961	923521
842	708964	882	777924	922	850084	962	926444
843	710649	883	779589	923	851929	963	928369
844	711336	884	781456	924	853746	964	929296
845	714025	885	783225	925	855625	965	931225
846	715716	886	784996	926	857476	966	933256
847	717309	887	786769	927	859329	967	935089
848	719004	888	788544	928	861184	968	937024
849	720801	889	790321	929	863041	969	939961
850	722500	890	792100	930	864900	970	940900
851	724201	891	793081	931	866761	971	942741
852	725904	892	795664	932	868624	972	944784
853	727609	893	797449	933	870489	973	946729
854	729316	894	799236	934	872356	974	948676
855	731025	895	801025	935	874225	975	950625
856	732736	896	802816	936	876096	976	952576
857	734449	897	804609	937	877869	977	954529
858	736164	898	805904	938	879844	978	956484
859	737681	899	808201	939	881721	979	958441
860	739600	900	810000	940	883600	980	960400
861	741321	901	811801	941	885481	981	962361
862	743044	902	813604	942	886364	982	964324
863	744769	903	815400	943	889249	983	966289
864	746496	904	817216	944	891136	984	968256
865	748225	905	819025	945	893025	985	970225
866	749956	906	820836	946	894916	986	972196
867	753689	907	822649	947	896809	987	974169
868	753824	908	824464	948	898704	988	976144
869	755161	909	826281	949	900601	989	978121
870	756900	910	828100	950	902500	990	980100
871	758641	911	829921	951	904401	991	982081
872	760384	912	831741	952	906304	992	984064
873	762129	913	833569	953	908209	993	986049
874	763776	914	835369	954	910016	994	988036
875	765625	915	837225	955	912025	995	990025
876	767376	916	839056	956	913936	996	992016
877	769129	917	840789	957	915849	997	994009
878	770884	918	842724	958	917764	998	996004
879	772641	919	844561	959	919681	999	998001
880	774400	920	846400	960	921600	1000	1000000

Inch	Square	Inches	Squares	Inch.	Square	Inch.	Square
1001	1002001	1041	1082681	1081	1168561	1121	1256641
1002	1004004	1042	1085764	1082	1170724	1122	1258884
1003	1006009	1043	1087849	1083	1172889	1123	1261029
1004	1008016	1044	1089936	1084	1175056	1124	1263376
1005	1010025	1045	1092025	1085	1177225	1125	1265625
1006	1012036	1046	1094116	1086	1179396	1126	1267876
1007	1014049	1047	1096209	1087	1181569	1127	1270029
1008	1016064	1048	1098304	1088	1183744	1128	1272384
1009	1018081	1049	1100401	1089	1185921	1129	1274641
1010	1020100	1050	1102500	1090	1188100	1130	1276900
1011	1022121	1051	1104601	1091	1190281	1131	1279161
1012	1024144	1052	1106704	1092	1192464	1132	1281424
1013	1026196	1053	1108809	1093	1194649	1133	1283689
1014	1028196	1054	1110916	1094	1196836	1134	1285956
1015	1030225	1055	1113025	1095	1199025	1135	1288225
1016	1032256	1056	1115136	1096	1201216	1136	1287496
1017	1034289	1057	1117249	1097	1203409	1137	1292769
1018	1036324	1058	1119364	1098	1205604	1138	1294094
1019	1038361	1059	1121481	1099	1207801	1139	1297321
1020	1040400	1060	1123600	1100	1210000	1140	1299640
1021	1042441	1061	1125721	1101	1212201	1141	1301881
1022	1044484	1062	1127844	1102	1214404	1142	1304164
1023	1046529	1063	1129969	1103	1216609	1143	1306449
1024	1048576	1064	1132096	1104	1218816	1144	1308736
1025	1050625	1065	1134225	1105	1221025	1145	1311025
1026	1052676	1066	1136358	1106	1223396	1146	1313316
1027	1054729	1067	1138489	1107	1225449	1147	1315509
1028	1056784	1068	1140624	1108	1227664	1148	1317904
1029	1058841	1069	1142761	1109	1229881	1149	1320201
1030	1060900	1070	1144900	1110	1232100	1150	1322500
1031	1060961	1071	1147041	1111	1234321	1151	1324801
1032	1065024	1072	1149184	1112	1236544	1152	1327104
1033	1067089	1073	1151329	1113	1238769	1153	1329409
1034	1069156	1074	1153476	1114	1240969	1154	1331716
1035	1071225	1075	1155625	1115	1242625	1155	1334025
1036	1073296	1076	1157976	1116	1245459	1156	1336336
1037	1075369	1077	1159929	1117	1247689	1157	1338649
1038	1077444	1078	1162074	1118	1249924	1158	1340964
1039	1079521	1079	1164241	1119	1252161	1159	1343381
1040	1081600	1080	1166400	1120	1254400	1160	1345600

Inch.	Squares	Inches	Squares	Inch.	Squares	Inch.	Squares
1161	1347921	1196	1430416	1231	1515361	1266	1602756
1162	1350244	1197	1432809	1232	1517824	1267	1605289
1163	1352569	1198	1435204	1233	1520289	1268	1607824
1164	1354896	1199	1437601	1234	1522656	1269	1609361
1165	1357225	1200	1440000	1235	1525225	1270	1612900
1166	1358556	1201	1442401	1236	1527696	1271	1615441
1167	1361689	1202	1444804	1237	1530169	1272	1617984
1168	1364124	1203	1447209	1238	1334244	1273	1620529
1169	1366921	1204	1449616	1239	1535121	1274	1622076
1170	1368900	1205	1452025	1240	1537600	1275	1625625
1171	1371240	1206	1454436	1241	1540081	1276	1628176
1172	1373584	1207	1456849	1242	1542564	1277	1530729
1173	1375929	1208	1459264	1243	1545049	1278	1633464
1174	1378276	1209	1461681	1244	1547536	1279	1635841
1175	1380625	1210	1464100	1245	1550025	1280	1638400
1176	1382979	1211	1466521	1246	1552516	1281	1640961
1177	1383329	1212	1468944	1247	1555009	1282	1643524
1178	1387284	1213	1471369	1248	1557504	1283	1645989
1179	1390041	1214	1473796	1249	1560001	1284	1645656
1180	1392400	1215	1476225	1250	1562500	1285	1651225
1181	1394761	1216	1478656	1251	1565001	1286	1653796
1182	1397124	1217	1480989	1252	1567504	1287	1656369
1183	1399489	1218	1483924	1253	1570009	1288	1658944
1184	1401856	1219	1485961	1254	1572416	1289	1661521
1185	1404225	1220	1488400	1255	1575025	1290	1664100
1186	1406606	1221	1490841	1256	1577536	1291	1666681
1187	1408904	1222	1493244	1257	1580049	1292	1669264
1188	1411124	1223	1495729	1258	1582564	1293	1671849
1189	1413711	1224	1498246	1259	1585081	1294	1674336
1190	1416100	1225	1500125	1260	1587600	1295	1677025
1191	1418481	1226	1503076	1261	1590121	1296	1679616
1192	1420864	1227	1505529	1262	1592644	1297	1682209
1193	1423249	1228	1507984	1263	1595169	1298	1683804
1194	1425639	1229	1510441	1264	1597706	1299	1687401
1195	1428025	1230	1512900	1265	1600225	1300	1690000

CHAP.

CHAP. XI.

Shewing, how to Hang a Riſing line by ſeverall Sweeps, to make it rounder aftward, then at the beginning of the ſame.

IF any be deſirous to have a Riſing line rounder aftward then it is at the foar part of it, they muſt proceed thus; firſt Work by the Sweep that they would have firſt, and then begin again, and finde the other Sweep, that they would have the roundeſt; An *Example* of this will make it more plain, as in the following Figure will appear.

Let D E repreſent the length of a Riſing line E I, the height thereof 8 foot, on the after end thereof; firſt I finde the Sweep that Sweepeth it, by Multiplying of 20 foot the length, which is 240 inches: for if you look in the Tables, under the Title of Feet-Inches, for 20 feet, you will ſee in the next Columne, toward the left hand, 240, over head is written Inches, ſignifying, that in 20 feet is 240 inches; and juſt againſt it, and in the ſame line, toward the right hand, under the Title of Squares, you will ſee written 57600, ſignifying, that the ſquare of 240 is 57600, theſe numbers you will finde in the ſecond Page of the Tables, and the laſt line, the ſeventh, eighth, and ninth Columns.

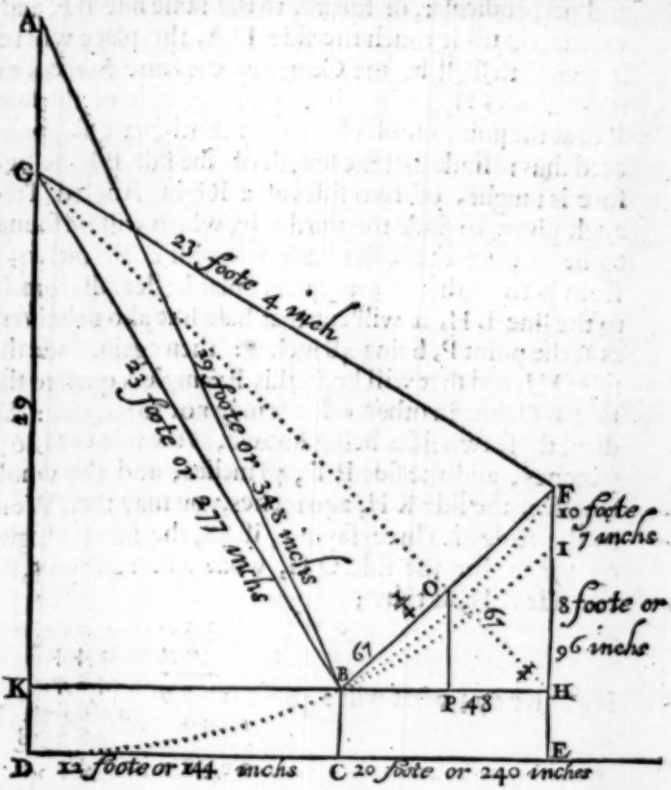
This

This ſquared number 57600, made by the Multiplication of D E, 240 inches, muſt be divided by the height of the Riſing line aſſigned E I, 8 foot, or 96 inches, ſo remaineth in the quotient 600, to which muſt be added the height of the Riſing, as is afore taught, and they make 696, which is the Diameter of the whole Circle: the half thereof is 348 inches, which is 29 foot, as you may ſee by dividing it by 12; or elſe, if you turne to the Tables, and ſeek under the Title of *Inches* for 348, you will ſee in the ſame line, toward the left hand, 29 feet, which you will finde in the third Page, and the 28th line, the ſeventh and eighth Columns; then I Work by that Sweep to $\frac{1}{7}$ of the length of the Riſing line, or ·2 foot of the ſame, at the point C it is repreſented, at which point I ſeek the Riſing C B, I ſeek in the Table for the *Square* made of 144, and I finde it in the ſecond Page, 24 line, at the firſt Columne; and toward the right hand, under the Title of *Squares*, I finde 20736, which is the Square made of 144: then I ſeek for the Square made of the Sweep, or ſide A B, 348 inches, and I finde it in the Tables to be 121104, from this 121104 I Subſtract the other Square, made of the ſide D C, 144 being 20736, and there remaineth 100368, whoſe Root I finde in the Tables, in the third Page, and the 37th line, and the ſixth Columne, 100489, which is too much by neare 121; but the other number afore it being much more too little, the number anſwering hereunto is 316 inches, and near $\frac{1}{4}$, Subſtracted from 348, the whole ſide leaveth 31 inches $\frac{3}{4}$, or two foot 7 inches $\frac{3}{4}$ for the Riſing,

```
                0
               30
57600 (600     96
 9666          ##
  ##
```

121104
20736
100368

ſing, at the point C: Now to make a rounder Sweep aſtward on, or at the other end of the line, as from B to F, which runeth higher up, or Roundeth more, as from I to F: Here will be ſomething more of trouble to finde the Sweep that ſhall exactly touch the two points aſſigned, as from B to F; then to finde the former Sweep. Now the Demonſtration wil ſhew it to be thus.



Let

Let B and F be the two points to which the Sweep is confined to touch; draw a ſtreight line from B to F, as you ſee, and ſo you have a Right lined Triangle, made of the ſides B H, the length of the line to be ſwept by the ſecond Sweep, and the ſide H F, the height of the ſame, together with the Subtending ſide B F; then a ſtreight line drawn from the middle of the ſide B F, and perpendicular, or ſquare, to the ſame line B F, and extended, till it touch the ſide D A, the place where it toucheth ſhall be the Centre of the ſame Sweep, as is the line G H, paſſing through the middle of the ſide B F, at the point O, which to finde Arithmetically, proceed thus; finde firſt the length of the ſide B F, as before is taught, of two ſides of a Right Angled Triangle given, to finde the third ſide, which will be found to be 134 ½ inches, the halfe whereof is 67 inches, & from B to O, then if a perpendicular be let fall from O to the line B H, it will cut that Baſe line alſo in halves, as at the point P, being 48 inches: then again, finde the ſide O H, and that will be, in this Example, equall to the ſide B O, but in other caſes it may not ſo fall out: So then, thoſe two ſides being known, as the ſide O H, 67, ½ inches, and the ſide P H, 48 inches, and the whole length of the ſide K H, 240 inches, you may then Work by the Rule of Three, ſaying, if 48, the ſide P H, give 67 ½ inch, for the ſide O H, what will 240 give, for the ſide K H, as thus;

If 48 give 67 ½, what will 240

240
67
1680
1440
16880

2
244
4640
2608o(135
48888
44

If

If you Multiply the two first numbers together, and divide by the first number, you will beget in the quotient 335, for the length of the whole side G H.

I here neglected the ½ inch in this Multiplication, for the ½ inch should have been Multiplied into the 240, by adding to the Summ 16080,120, the halfe of 240, and it maketh 16200, which divided by 48, maketh 337 ½ inches for the whole side G H; So then, these two sides being found, find the side G K, thus, as before is taught, look in the Table of *Squares*, for the *Square* made of the side 337, and it will be 113569, from which Substract the *Square* made of 240, the other side, being 57600, there resteth 55969, as you may see, for that number sought for in the *Tables*, and you find the neerest number to it, to be 56069, and the roote of it to be 237, for the side G K, to which must be added the Rising of the point C B, or K D, which is all one, and is as we found it before to be, 31 ½ inches, added to 237, maketh 268 ½ inches, or 22 foot 4 inches; shewing, that at 22 foot 4 inches, from the point D, towords G, will be the point where the Centre of the Rounder Circle ought to stand: Then again, you have the side G K, found as before, to be 237, and the side K B 144, and if you work as is taught before, but remember, that if the longest side be sought for, as is now in the last side sought for, G B being the longest side, you must add the squares made of the other two sides together, and the square of those two Summs shall be the longest side G B, 277 inches, that is 23 feet, 1 inch, which is the length of the second Sweep: and so have you the length of the Sweep. The same order you may observe to round your Sweep as often as you please.

113569
57600
55969

237
31 ½
268 ½

If any have knowledge of the Doctrine of *Triangles*, it may be found more readier, that I leave to those that know the use thereof.

Note alſo, that when you ſeek for any number in the *Tables*, take heed that you minde the number of Figures you ſeek for, to agree in number with thoſe that directeth you to ſeek for them.

As for *Example*, In the other figures abovementioned, 55969, they are in number 5, by their places, as you ſee; then repairing to the Table, I finde 559504, but telling the Figures, I ſee that they are in number 6, but ſhould be but 5: therefore this number, repreſented in the ſeventh Page; and the 28th line, and third Columne, is not the place I ſeek for, then I turne toward the beginning of the Table, till I ſee that the Columnes of *Squares* contain but 5 figures, and there ſeek the neareſt number agreeing to 55969, and in the ſecond Page, 37th line, laſt Column, I finde 56069, the neareſt agreeing to it, which is the place anſwering to the other directory figures.

Note alſo, That the *Example* of finding the Sweep aforegoing, is laid down by the ſmall Scale of the *Draught*, by which you may trie it for your better directions.

And in that Table you may ſee that any farther then 70 foot, being the end of the ſeventh Page, I have not mentioned the *Feet* and *Inches* belonging to the number of *Inches*, but have left it out becauſe they are of little uſe any further, becauſe that will reach farr enough for the length of any Riſing line of any Ship whatever: If any be deſirous to convert any of the following numbers into inches, he may do it by Dividing by 12.

Thus I think I have ſpoken enough to the Ingenuous, concerning the ſingular uſe of the *Tables*, or of this way of Working by Segments o Circles.

CHAP.

CHAP. XII.

Concerning Measuring of Ships.

I Shall say something concerning it; the Shipwrights have to themselves a custome of measuring at *London*, or on the River of *Thames* thus, they multiply the length of the Keel into the bredth of the Ship, at the broadest place, taken from outside to outside, and the product of that by the half bredth, this second product of the multiplication they divide by 94 or sometimes 100, and according to that division, the quotient thereof; they are paid for so many Tuns; as suppose in the former draught being in length 60 foot and 20 foot broad, 60, being multiplyed by 20, the bredth, produce 1200, that 1200 being again multiplied by 10, the half bredth produce 12000, if you divide by 100, you need do no more than cut off the two last figures toward the right hand, which shall be the answer and rendreth the Ship to be 120 Tuns, but if you divide the sum 12000 by 94, you wil have 127 $\frac{1}{2}$ of a Tun very neer, but this cannot be the true ability of the ship to carry or lift, because two ships by this rule of equall breadth and length shall be of equall burthen, notwithstanding the fulness or sharpness of those Vessels, which may differ them very much, or the one ship may have more timber than the other in her building, & so shall carry less than the other: But the true way of measure must be by measure of the body and bulk of the ship underwater, for if one ship be longer in the floor than another of the same bredth and length, she shall be more in burthen than the

60
20
1200
10
12000

other; as a Flemiſh ſhip ſhall carry more than a French or Italian Veſſell of the ſame length and bredth; Therefore I ſay the meaſure of the ſhip being known by meaſuring her, as a piece of timber may be meaſured of the ſame form, to the draught of water aſſigned her, the weight of the ſame body of the ſame water that the ſhip ſwimmeth in ſhall be the exact weight of the ſhip, and all things therein; loading, rigging, victuals included therein: then if the ſhip be meaſured to her light mark as ſhe will ſwim at being lanched, the weight of ſo much water being taken or ſubſtracted from the weight of the water when ſhe is laden, the reſidue ſhall be the weight that muſt load her, or her ability of carrying, called her burden, by this means you may know the weight of the ſhip light, and what ſhe will carry to every foot of water aſſigned to her, which cannot be done by no general rules in Arithmetick becauſe of their great irregularity, according to the differing minds of Shipwrights; you may if you pleaſe firſt meaſure the content of the Keel and Poſt and Stem-rudder, all of it that is without the Plank, and under the water line, and note it by it ſelf, then meaſure the body of the ſhip in the Midſhips, made by the ſquare made of the multiplying of the depth of the water line, and the bredth, then you may find; the content of the want by the circular part of the ſhip under water, being narrower downward, and ſubſtract this from the whole content of the ſquared body of the depth of the Water-line and bredth of the ſhip, and this ſhall be the ſolid content of that part of the ſhip, I mean in ſolid foot meaſure of 1728 inches to the foot, then proceed to the fore part or the after part of the ſhip, and to 3 or 4 Timbers more, find the mean bredth at the narrowing aloft at the water-line, and alow at the floor and the mean depth, and meaſure that piece of

the

the ſhip, as I told you of the middle part of the Ship, and ſo meaſure the whole Ship by pieces and add them together, and ſo many feet as it maketh, ſo many feet of water ſhall be the weight of the ſaid ſhip; and the reaſon may be conſidered thus; there is a ponderoſity in warer, but there is a greater in the ayre, onely to the heavieſt of things; and there is a ponderofity in water it ſelf, but not ſo much as in other things more ſolid as in Iron: Suppoſe a Gun or an Anchor of Iron, it ſinketh in the water, but yet it is not ſo heavy in the water as in the ayre, by the weight of ſo much water as ſhall make a body of the ſame water equal to the body of the Gun or Anchor in magnitude; which weight ſubſtracted from the weight of the Iron body weighed in the ayre, and ſo much muſt be the weight of it in the water.

Again, if a body be lighter in weight, than water of the ſame bigneſs, it hath an ability of lifting in the water, and can lift or carry ſo much as is that difference, as a piece of cork or wood of firr-trees, being lighter than water, it ſwimmeth on the face of the water, and refuſeth to be depreſſed without more weight added to it.

Thus a ſhip being a concave body, is made capable of lifting according to the greatneſs or littleneſs of this concavity, reſpect being had to the greatneſs of the Timber put into it, or the nature of it, all which maketh a ſhip ſwim deeper or lighter in the water.

I have proved by the *Thames* water, that freſh Water is lighter then ſalt water, ſo then ſalt water being heavier than freſh, cauſeth that a ſhip ſwimmeth deeper in the freſh water than in ſalt.

I ſhall not need to ſay any thing more concerning the meaſuring, for it will be underſtood by thoſe that have any judgement.

Judgment in the meſuring of triangles, the matter it ſelf being but a nicity rather than uſefull: I only touched it to ſhew thoſe that are ſo curious minded, which way they may accompliſh their deſires; I ſhall forbear to give examples, becauſe it will much increaſe my Treatiſe, and augment the Price, which might prove more prejudicial to youngmen than advantagious.

CHAP. XIII.

Concerning the Maſts of Ships.

FRom the length and bredth is gained the Mainmaſts length, and all the other Maſts aswel as yards, is derived from thence, and there is different proceedings in this caſe, according to the largeneſs of the Ships, thus, the main Maſts of ſmall Ships to be three times as long as the Ship is in bredth; as a ſhip of 20 foot broad, by the ſame rule muſt have a Maſt of 60 foot long.

Others for greater Ships, add the bredth to the length, and to that the half bredth, which ſome they divide by 5, and the quotient is the number of yards, as a ſhip 114 foot long and 34 foot in bredth, as the bredth added to the length, and the half bredth added together, make 165, that divided by 5, yields 33, and ſo many yards is the length to be of that Maſt, the fore-maſt muſt be a yard ſhorter at the head, that is to ſay beſides the height of the ſtep, which commonly in moſt ſhips the ſtep of the fore-maſt ſtandeth higher from the bottom of the ſhip than the ſtep of the Main-maſt; the foremaſt muſt be ſhorter by that difference, and one yard more, or the bigneſs of the ſhip conſidered, 4 foot ſhorter at the head, or beſides the difference below,

114	
34	
17	
165	
x 5	
165	(33
15	

The Top-maſts two thirds of the length of the lower Maſts.

The

The Main-yard to be $\frac{2}{7}$ and $\frac{2}{11}$ of the Main-maſt, as in the Maſt aforementioned of 60 foot long, two thirds of 60 is 40, and the $\frac{2}{11}$ of 60 is 5, added to 40 make 45, for the length of the main yard.

The foreyard to be $\frac{6}{7}$ of the Main-Yard, as the Main-yard being 45 foot, divide 45 by 7, ſo cometh 6 in the quotient, and a fraction remaining of 3, ſignifying $\frac{3}{7}$, ſo that the $\frac{6}{7}$ of 45 will be 6 and $\frac{3}{7}$, you muſt take 6 times ſo much, as 6 times 6 makes 36, and if you take 6 times $\frac{3}{7}$ make $\frac{18}{7}$, that is, two whole numbers, and $\frac{4}{7}$ remaining, which added to 36, make 38, and $\frac{4}{7}$ of a foot for the length of the fore-yard.

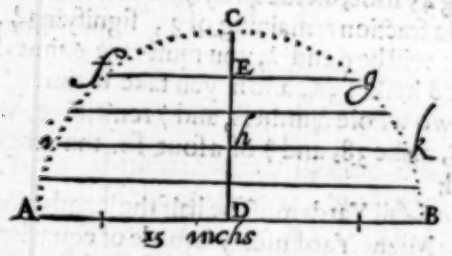
The Top-ſail Yards muſt be half the length of the lower Yards, the Mizne Yard uſualy is made of equal length with the fore-yard, the Croſjack yard, of equal length with the Main top-ſail yard, and the mizen Top-ſail yard to be half the length of the Croſjack yard.

The mizen Maſt to be of the length of the Main-top maſt from the upper Decks, and ſo much longer as is the height of the ſhip between Deck, the Boltſpreete to be of length equal to the fore-maſt from the upper Deck of the Fore-caſtle upwards.

For the bigneſs of theſe Maſts, to a yard in length, $\frac{1}{4}$ of an inch, or elſe $\frac{1}{2}$ of an inch to the foot, and ſo of yards likewiſe, only the Boltſpreet ſomthing bigger, would be the better if he be made as big as the fore-maſt.

The Spritſail yard in length $\frac{1}{2}$ of the Boltſpreete, the Spritſail to ſail yard as of the reſt, to be $\frac{1}{2}$ the ſpritſail yard, the mizen yard in bigneſs, but $\frac{1}{4}$ inch to a yard: And directing my diſcourſe to Young-men that deſire inſtructions, I will avoid troubling of them as neer as I can with Arithmetick, therefore I will ſhew them the ſweeping out of Maſt and Yards, for the filling up their Quarters accordi-

ding to circles. Thus, make a half circle equal in diamiter to the bigneſs of the Maſt, in the partners, or if it be a Topmaſt, equal to his bigneſs in the Cap; as ſuppoſe for to make a Maſt 60 foot in length, then by the former directions ¼ of an inch for his bigneſs to a foot, rendreth him to be 15 inches



thorow, but for a Main-maſt it is alwaies better that they be made bigger, to everie 6 inches ad ¼ of an inch more, ſo then this Maſt will be 16 ¼ inches, I make a ſweep of 16 ¼ inches, as from A to B, ſuppoſing the feet of the ſmall ſcale, to be inches, draw, the Sweep or Arch A C B, 15 inches from A to B, than at the Centre draw a line perpendicular to A B, as from D to C, divide the perpendicular into four equal parts, with the compaſſes, & ſet off 3 of them, on the perpendicular from D to E, and through that point draw a line parallel to A B, as is the line *f g*, which ſhall be the bigneſſe of the Maſt at the Hounds, then middle the ſpace between D & E as at *h*, and draw the line *i k*, which ſhall be the bigneſs of the Maſt at the middle, then two other lines drawn again through the middle between D *h* & another between *h* E, ſhall be the bigneſs of the Maſt in the quarters, ſo then take off from the ſweep, the bigneſs at each place from the midle line D C, to the arch, & in like māner middle the maſt

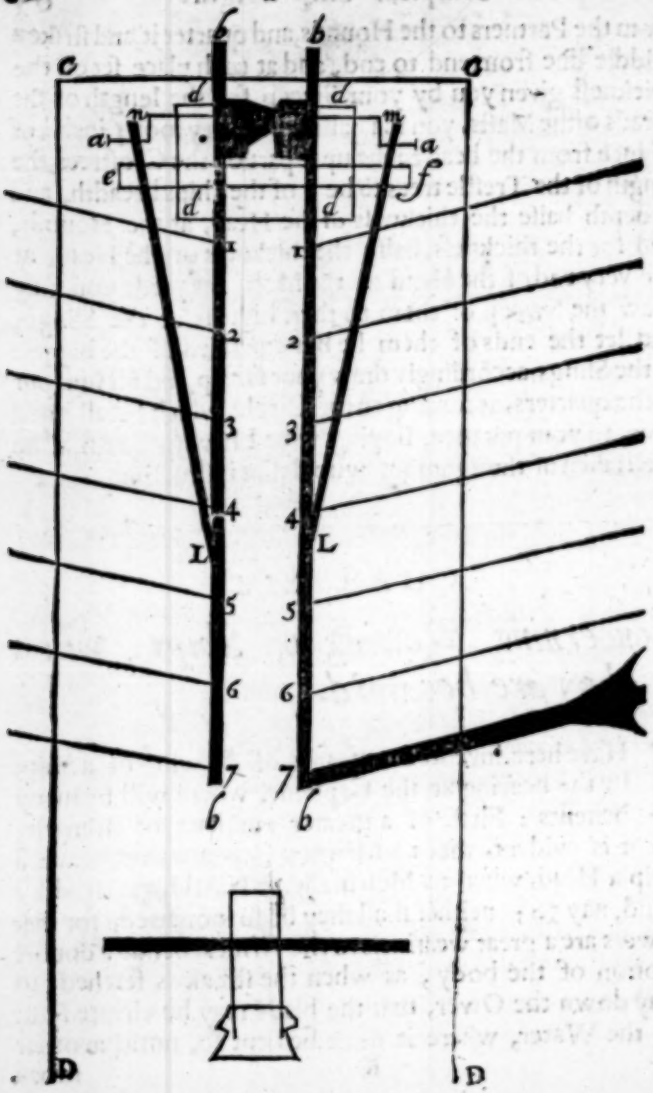
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from the Partners to the Hounds, and quarter it, and ſtrike a middle line from end to end, and at each place ſet off the thickneſs given you by your Sweep, for the length of the Heads of the Maſts, you may allow to every foot 1 inch ½ of an inch from the head to the uper part of the Croſtrees, the length of the Treſtle trees to be ⅓ of the Ships breadth, and in depth halfe the thickneſs of the Head, at the Hounds, and for the thickneſs, halfe the thickneſs of the Head, at the very end of the Head of the Maſt, for yards you may draw the Sweep of them to their bigneſs at the Slings, and let the ends of them be but one third of the bigneſs in the Slings, accordingly draw your ſweep, and fill him out in the quarters, according to the Circle, which I ſhall leave now to your practice, hoping, what I have ſpoken ſhall be well taken of the ignorant, who deſire inſtructions.

CHAP. XIV.

Concerning Rowing of Ships, when they are becalm'd.

I Have here invented a meanes of Rowing of a Ship, by the heaving at the Capſtane, where will be many benefits; Firſt, of a greater purchaſe of ſtrength, for it is evident, that 10 Men at a Capſtane ſhall heave a Ship a Head, when 30 Men ſhall not Haall her a Head by hand, nay 50; neither ſhall they be ſo ſoon tired, for that Owers are a great wearineſs to the Armes, beſide a double motion of the body, as when the ſtroak is fetched, to way down the Ower, that the blade may be elivated out of the Water, where it muſt be kept ſo, untill another


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ſtroak be fetched, and then great ſtrength put to the Ower by the Armes, or elſe heavy bodies, will not be moved: beſide, if you have never ſo many Owers as you can put, they all fetch their ſtroak at once, but when Rowed by hand, one is likely to fetch a ſtroak before another, ſo that much of the ſtrength is loſt by a diſagreement in the labour: But to proceed to the deſcription of this invention.

Let the two lines, C D, and C D, repreſent the ſides of the Ship, 16 foot broad, as is the line C C, 16 foot long, by the Scale of the *Draught*; and let the two long ſquares, *d d*, and *d d*, repreſent the two Bitt-pins, with the Croſs-piece *e f*, let the Black, between the two Bit-pins, repreſent a Roule, or Windleſs, with a Surdge in the middle, as is the Surdge of a Crab, or Capſtane; in the two ends of this Roule let there be placed two Winches, as you may ſee repreſented by Cranks, *a* and *a*; let there be made a hollow place in the Head of the Bit-pins for theſe two Winches to reſt in, that they may turne round in them, and bide in them: then let there be two pieces of Timber, equall in length, to the ſpace of the Ship you would have filled with Oares, repreſented by the two black liſts, marked *b b*, and *b b*; then let there be fitted two ſmall pieces, made of good Aſhe, or ſome good ſtrong Wood, of equall length as is the two black Liſts, *n* L, *m* L, faſtned into the pieces of the frame, as at the points L and L, by a Boult, but ſo, that they may play on that Boult; and the other ends muſt be with a Hoale made in the ends, put over the handles of the Cranks, at *n* and *m*, then in the two long pieces for the frame let the Oares be fixed, as at the points 1, 2, 3, 4, 5, 6, 7, of each ſide of the Ship repreſenting 7 Oares of a ſide, they may be faſtned in the Frame, by a Mortis made therein, and a Tenent on the Oar, made to go ſlack, in that the Oar may play, and have liber-

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ty to fetch a Stroak, in the middle whereof must be [illegible] a Iron bolt, to fasten him, and keep the Oar from launching in and out, and on the Roughtre, or side of the Ship, as in C D and C D, must be placed Thoule pins to each Oare, as in Boats that Row; then must you have a Halser splised together, in manner of a Viall, that must take two or three turnes about the Roule, in the Surdge, as you may imagine, at the middle of the Black Roule, or notch therein, and pass from thence to the Capstane, with two or three turnes there also; then this Viall also, reeved thorough some other Blocks, as in manner of Snach block, and these blocks placed between the Capstane and the Roule, you may thereby increase that purchase so, as that it may heave very easie, and with great strength, so as to be able to Row a Ship a Head in a calme, or in little winde, two, three or four leagues, a watch or more, according as the Ingine shall be better or worse fitted; for if you marke in the Figure of the Work, and suppose the Viall Reeved, and by heaving of the Capstane, shall turne the Roule, as the Crankes goeth round, it shall carrie with it about, and then the small pieces shall cause the frame to pass forward to and again, to fetch a stroake with the Oares.

FINIS. A. 663.